PUBLIC WORKS

City, County and State

THE MANUAL OF SEWAGE DISPOSAL EQUIPMENT

A COMPLETELY rewritten, up-to-date and enlarged edition has just been issued by the publishers of this magazine. It contains 112 pages and more than 100 illustrations.

The editor of PUBLIC WORKS, A. Prescott Folwell, is the author. In this volume, Mr. Folwell tells concisely, but fully, the functions of all classes of equipment, explains what they are intended to accomplish, discusses their use in relation to design and gives the names of the manufacturers of all types. Chemical treatment of sewage and control equipment for it are treated in separate chapters.

The data which Mr. Folwell compiled and published in The Manual are essential when designing sewage treatment plants and heretofore not available in one handy volume.

Every one concerned with sewage should have a copy. A limited number of overprints are available for direct sale at $2 per copy. Address orders to

PUBLIC WORKS Magazine

310 East 45th St. New York, N. Y.

JUST OFF THE PRESS

AUGUST, 1935

DUST STORMS

like this can be controlled

THOSE dust storms which ravaged the western plains last spring were fearsome things. And nothing could be done to curb them.

Though more local, the dust clouds raised by passing vehicles and blown from dirt and loose-gravel roads are relatively even more damaging. Not only are they a detriment to lawns, gardens, orchards and roadside crops . . . they are a real menace to health; obscure motorists' vision and invite accidents; smudge up home interiors, ruin furnishings and exasperate housewives. . . . What's more, they carry away tons of valuable material from every stretch of roadway. (One highway engineer estimates the loss at 115 cubic yards per mile annually on roads carrying 400 vehicles a day.)

Such material loss alone is greater than the cost of saving it. And it can be saved—economically—through the use of Calcium Chloride as a dust palliative or road-material "stabilizer." To this add the potential saving in maintenance; the saving in human health and lives, property and crops; and the contribution made to the comfort of both motorists and residents.

The maintenance of secondary or "feeder" traffic arteries devolves almost wholly on county and local highway departments. Controlling dust and thus stabilizing and making dirt and gravel road surfaces smoother, easier riding and longer lasting, is one of the wisest measures road officials can take. It not only makes the ruralite's road-tax dollars go farther but evokes his heartfelt gratitude as well.

(Gravel-and-soil stabilization through the moisture bond afforded by Calcium Chloride is now definitely controllable—through formulæ and techniques developed by soil scientists and highway engineers, aided by extensive researches made by the U. S. Bureau of Public Roads.) For free literature on road-dust control and "soil-stabilized" road surfaces, write to any of the following members of the CALCIUM CHLORIDE ASSOCIATION:

The Dow Chemical Company . . . . . . Midland, Michigan
The Columbia Alkali Corporation . . . . . Barberton, Ohio
Michigan Alkali Company . . 60 E. 42nd St., New York City
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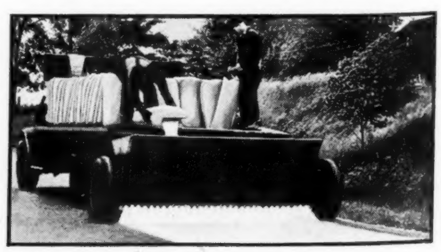


CALCIUM CHLORIDE

F O R S T A B I L I Z I N G R O A D S U R F A C E S

VOL. 66 PUBLIC WORKS No. 8
Entered as second-class matter at the Post Office at New York, N. Y., Sept. 1, 1922, under the act of March 3, 1879.
Published Monthly by PUBLIC WORKS JOURNAL CORPORATION, 310 East 45th St., New York, N. Y.
Subscription Rates: United States and Possessions, Mexico and Cuba, $3.00. All other countries, $4.00.
AUGUST, 1935

August
1935

PUBLIC WORKS

Vol. 66
No. 8

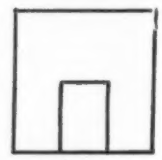
CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

TABLE OF CONTENTS, AUGUST, 1935

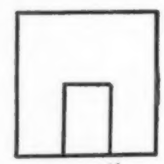
TIMEWASTERS:

A TVA Problem:

At any rate it was given us by an engineer of the Tennessee Valley Authority, and it is worth passing on to our little group of serious thinkers who specialize on timewasting. You will note at the right of this paragraph the plan and the front view of a structure. The problem is to draw a side view of the same structure without using any dotted or hidden lines. It can be done; and in fact has been done with success. If the reader, after working earnestly at this for two hours cannot work out the side view, he is advised to spend another hour looking through the various pages of this magazine. The side view of the said structure will be found on another page. Where? Well, that's another problem. The problem, by the way, was contributed by our old friend WGS of Knoxville.



Plan



Front View

"Hello, Timewasters!"

So says our good friend Walter S. Wheeler from out in the cool areas of New Hampshire. At least we hope they are cool. New York isn't quite, at this writing. Nor was Carlisle Barracks, Pa., where we spent two weeks in early July playing at soldiering again. But to get back to Mr. Wheeler. He submits the following contrib to Timewasters:

A round pipe laid straight and level crosses a straight and level street on an angle. On a vertical cross-section drawn at right angles to the street, this pipe is shown as a perfect circle on account of the distorted scale which is 1 inch equals two feet horizontal and 1 inch equals one foot vertical. At what angle does the pipe cross the center line of the street?

And Now!

All this doesn't leave much room for solutions of last month's Timewasters, so these will have to go over till next month. Maybe it won't be so hot then, anyway. But in the meantime, ladies and gentlemen, our supply of ammunition is getting low. Who will add a few fagots to the dwindling flames by sending in one, two or more suitable problems to keep our fans from getting cobwebs in their thinking machines?

W. A. H.

SUBSCRIPTION RATES: United States and Possessions, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

A. PRESCOTT FOLWELL, *Editor* **W. A. HARDENBERGH,** *Asso. Editor*

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising representatives,* S. N. HUME, 310 East 45th St., N. Y.; FRED R. JONES, 100 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 1635 E. 25th St., Cleveland, Ohio.

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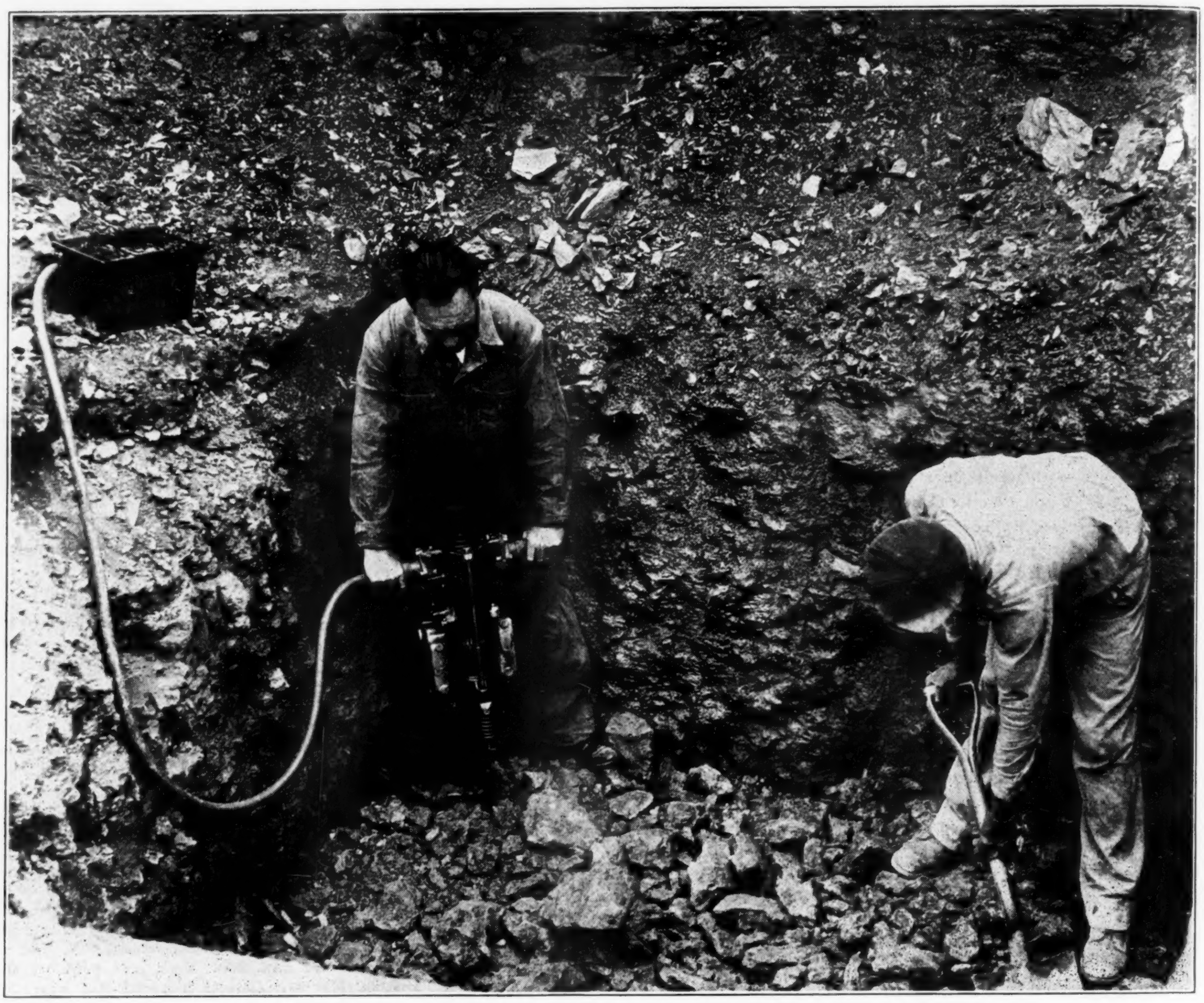


PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 66 | *August, 1935* | No. 8

A pink pavement in Galveston, Tex.

A green sidewalk in New Orleans

Color in Concrete Construction

BEAUTY in construction is being demanded more and more—not added frills but an harmonious treatment built into the design. There is a growing interest in color as a means of achieving the attractiveness demanded of modern designs. This was evidenced by the comments of visitors on the color presentations at the Century of Progress Exposition in Chicago.

It is up to the builders, engineers and planning boards to answer this demand for color with construction information and suggestions as to its use.

The small contractor has ventured into this field by constructing driveways, walkways, steps, tennis courts, etc., with colored concrete, or with concrete containing colored panels. Such construction harmonizes with the surroundings and relieves the severity of large areas of pavement or long walkways.

The architect in using colored concrete and stucco finds that panels of color make large wall areas interesting without the use of expensive formwork or special decorative treatment.

The engineer also is interested in learning of this new development. With color in concrete such utilitarian structures as water works, sewage treatment plants and water towers can be made much more attractive and the objection to their location near residential districts or parks will be minimized. Roadways, walkways, lighting standards, and terraces can all be made a part of the general color scheme.

City streets and highways may have built-in safety features such as colored concrete lines marking traffic lanes, parking spaces and route numbers at intersections.

Ordinarily, colored concrete is obtained by mixing mineral pigments in the cement paste, by the use of colored aggregates, or by a combination of both.

Manufactured pigments will give satisfactory results for nearly all ordinary purposes. The proportion of pigment to cement must be kept constant or the resulting color may show considerable variation. Pigments may be safely used in amounts up to 10 per cent of the weight of the cement (9 lbs. per sack). These limits may be exceeded with some pigments and under certain conditions, in which case the manufacturers' directions should be followed.

The aggregates used in making colored concrete should be as near the color of the mortar as possible. If such aggregates are not available, light colored, semi-transparent aggregates will give a good effect. Natural aggregates consist of granite, marble, micaspar, quartz, silica sand, etc.

The manufacture of colored aggregates is the subject of investigations which are now being made. It is hoped that suitable aggregates can be manufactured at low cost.

Colored concrete may be placed by any one of three recommended methods—two-course monolithic, regular two-course or the one-course method. Two-course monolithic is used when the colored concrete can be placed and finished before the base course hardens, as in driveways, tennis courts and walks.

The regular two-course method is best suited to floor

work where it is not desirable to place the topping until other construction work is completed.

One-course construction with colored concrete, in which the full thickness of concrete is placed, is seldom economical except for thin slabs or when only tints rather than deep colors are desired.

A wide variety of colors and textures may be secured by exposing the aggregate. A mix of yellow and white marble chips, or a mixture of gray granite screenings and black crushed slag with a little mica spar, are examples of possible variations.

A mix consisting of approximately 1 part Portland cement, 1½ parts of fine aggregate and 2½ parts of coarse aggregate made up of pebbles, crushed granite, etc., is used for the facing or topping.

For floors and walks, the two-course monolithic method may be used.

For walls and other vertical work, about 1 inch of facing concrete is placed against the form as the backing of ordinary concrete is placed, care being taken to see that the facing is placed in a manner that will insure its bonding with the backing. The level of the facing material usually is kept a few inches higher than the backing. When special metal or wooden molds are used to hold the facing concrete while placing the backing, the mold is removed before initial hardening occurs.

Contractors are becoming familiar with the details of colored concrete construction. The directions are easy to follow and in contemplating the use of color the engineer or achitect can be assured that any competent contractor will be able to produce the attractive results desired.

The Editor of PUBLIC WORKS will answer questions on the use of color in concrete structures and will give available data or references to it on request.

Experience With Trass Mortar Surfacings

The success of experimental sections laid with trass mortar in the Rhine Province in 1928-29 has led to an extended use of the material; the original method of construction has now been almost entirely superseded by the Verbunddecke (see *Road Abs.*, 1935-36, No. 108). A recently introduced proprietary cement consisting of trass and lime finely ground together, with subsequent addition of sodium silicate, gives, however, rapid hardening and high strength, and the simpler method of construction may regain its popularity in consequence. The Verbunddecke is constructed by spreading on a prepared foundation a mixture of nine bags of trass-lime and 1 cu. yd. of sharp sand; the mix is carefully levelled, and fine broken stone is spread evenly to a depth of about 3 in. The surface is then thoroughly rolled and watered. The wet mortar is forced into the interstices of the stone; it should not, however, reach the surface, and if necessary superfluous mortar should be removed to a depth of about 0.6 in. The surface is treated after drying (i.e., after 24 to 48 hrs.) with two applications of tarred stone chippings, each made at the rate of 24 lbs./sq. yd.; after thorough rolling, tarred gravel (0 to 0.2 in.) is added at the rate of 18.4 lb./sq. yd. In warm weather a final dressing of basaltic sand is advisable.

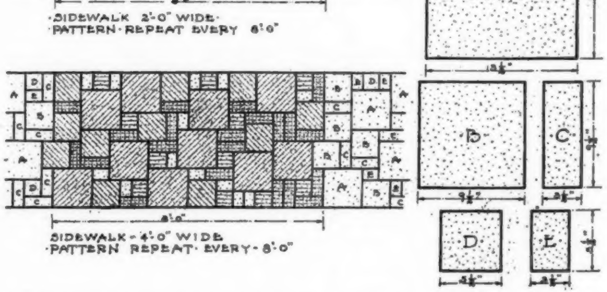
Trass surfacings (unless a specially modified trass-lime mixture is used) attain their full strength somewhat slowly; prolonged periods of wet and cold weather retard the process further, and it is therefore advisable to begin construction in the summer, in order that the surfacing may not be damaged by frost. Surfacings once thoroughly cured have proved exceptionally resistent to wear and impact, and are recommended for use over moist subgrades as an inexpensive substitute for tar or asphalt surfacings. It is advisable to apply a light surface dressing to the freshly dried surface; this not only retains the necessary moisture throughout the curing process, but prevents the washing away of the mortar before it has thoroughly set.

A difficulty in trass mortar construction has been to secure the proper adhesion of such dressings. Hot tar, which should be applied in dry weather, is superior to asphaltic emulsion for this purpose. The cost of trass mortar surfacings is less than that of Portland cement-bound macadam, and about the same as that of tar macadam or tar penetration surfacings. The costs of construction and maintenance of certain sections in the Rhine Province are tabulated. Failures, which have been comparatively few, are attributed either to construction too late in the season, or to exposure to exceptionally heavy traffic before the maximum strength of the surfacing had been attained.—GROSSJOHANN: *Verkehrstechnik*, 1935, 16 (3). 73-5.—*Road Abstracts.*

Making and Placing Concrete Flagstones

Concrete flagstones are adaptable to many uses. They make neat appearing and excellent walks around sewage treatment, water and other utility plants, and add a touch that is difficult to get at a comparable price in any other way. The illustration herewith shows five stock sizes, and the forms for them. By using ½-inch strips of wood for dividers, two of the forms can be used to cast all five sizes. Methods of laying to obtain a pleasing effect are also shown in the illustration.

A dry mix—about 5½ or 6 gallons of water per bag of cement—is best; a proportioning of 1:2½:3 is



Five stock sizes of forms and a few of the many patterns that can be made with them

preferable. Oil the forms well, and do a good job of finishing. Let the flags remain in the forms for 48 hours, then cure for 7 days under moist conditions. When the flags are to be supported on a firm base, as concrete, a thickness of 2 inches is enough; when they are to be set directly into the earth, make them 4 inches thick. In placing, leave ½ inch between. When set in the earth, this allows grass to grow between them; when set on a concrete base, colored mortar may be used. In fact the flags can be built of colored concrete, giving very effective results.

What County Engineers Want to Know

MANY requests reach us from our readers, asking for information on various phases of their work. Those requiring special information are answered direct, but a considerable number of the inquiries refer to matters on which there is considerable literature already available. In the article below, some 50 or 60 such questions are answered by reference to data which can be obtained readily.

A good many of the requests for information have to do with building and maintaining earth roads, dust control and stabilization. In the building of earth roads, drainage is a very important requisite, and the lack of drainage will greatly increase maintenance costs also. Little information on drainage is available in free booklets and pamphlets; it is desirable to refer to the two or three really good highway texts for this. Much will depend upon local conditions and materials.

Dust Control

Stabilization oiling or surface treatments eliminate the dust problem, and have many other advantages also. But for simple dust control, calcium chloride can be recommended. There are at least two excellent booklets on this subject which will be sent on request to the Editor. (Ask for Bulletin DC to obtain this group). One of these contains some 50 pages and is a good text on the subject, with complete directions, quantities required, etc.

Oiling also is an effective method of dust laying, and has an added advantage of waterproofing the road and, when properly done, of building up a traffic mat able to withstand the light traffic on less important roads. Several bulletins are available on this subject, which will be sent on request. (Ask for the OD group.)

Stabilization

Dust control makes the road safer by eliminating the dust problem; it also saves money by preventing the loss of surfacing material. But in most cases it is a palliative only, and applications of oil or calcium chloride must be repeated from time to time. Stabilization, on the other hand, provides a durable road surface for lighter traffic roads, and has the present decided advantage of utilizing considerable labor with low material cost.

The theory and the practical details of stabilized road construction have been covered in a number of articles in PUBLIC WORKS. A very fine article appeared in the December, 1933 and January, 1934, issues. A number of really excellent texts are available on request. Booklet S-1 on road surface stabilization contains in its 56 pages full instructions; S-2, S-3, and S-4 are other good texts, running up to 58 pages, which are available on request.

The basis of stabilization is a knowledge of soils. Every engineer should read the series of articles by C. A. Hogentogler in the May, July, August and September, 1934, issues of PUBLIC WORKS.

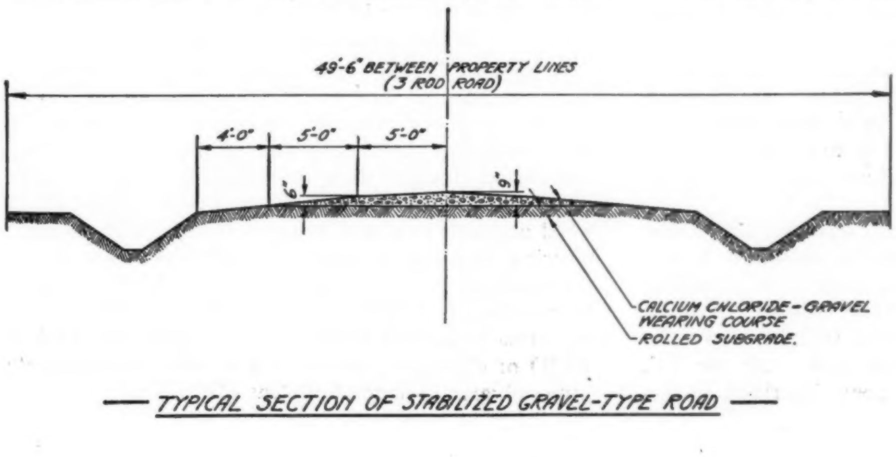
Surface Treatments

Light surface treatments have been found valuable in smoothing up old macadam surfaces, and in obtaining smooth, dustless and low-cost surfaces in gravel, cinder and earth roads. There is an extensive literature, thoroughly up-to-date, on this subject covering the use of both tar and asphalt. We have grouped these under the heading ST and will send on request some 4 or 5 excellent booklets These run in size up to 128 pages, and treat the subject exhaustively, yet simply and clearly. Nearly all of these have been written or revised within the past year and are fully up-to-date. If interested only in tar surface treatment methods, ask for STT; if in asphalt surface treatment only, for STA. The list of good booklets is too long to give here. Many of them are listed in the Readers Service Department of this issue of this magazine. All will be sent on request.

PUBLIC WORKS has printed a number of excellent articles on surface treatment. See the October, 1932, issue for the detailed methods recommended by the engineers of seven different tar and asphalt producers. Costs were given in this article; naturally they will vary with methods and localities. Maintenance costs on a surface-treated road, over a period of eleven years, were given in detail in an article in the May, 1934 issue of PUBLIC WORKS.

Preventing loss of road metal—or erosion—is accomplished by all these methods. Some actual cost data on savings by surface treatment were given in PUBLIC WORKS for May, 1933. This referred principally to gravel roads, on which a number of requests have been received.

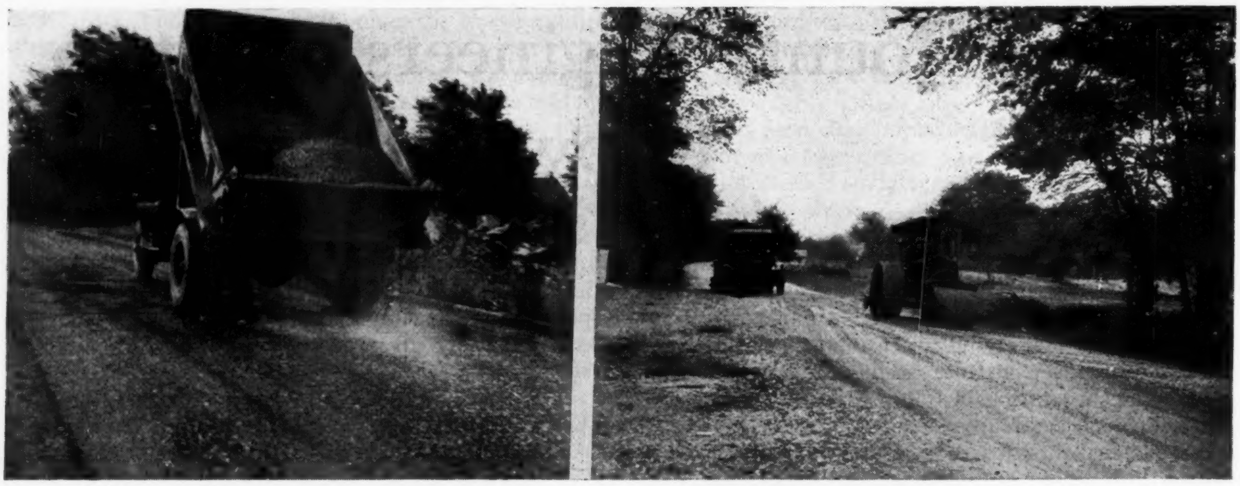
A considerable number of inquiries had to do with the treatment of gravel, traffic-bound and macadam roads using bituminous materials. In general, such information is given in booklets included in the abovementioned ST group. In addition we suggest booklets LC, which cover this subject well in 94 pages and LB, of 52 pages. The latter considers maintenance as well as construction, treating it thoroughly. Many of the ST booklets also have sections on maintenance.



— TYPICAL SECTION OF STABILIZED GRAVEL-TYPE ROAD —

Maintenance and Construction Equipment

In answer to a number of requests for information on equipment for such construction and maintenance work, we



Constructing Surface Treatment on a Gravel Road

suggest Bulletin RE, 72 pages, which is a very fair discussion of latest developments in tractors, graders, bituminous distributors, mixing plants, finishers, and other tools; and also 14 booklets on equipment, which we have grouped under the heading ME. These will be sent on request.

For other low-cost bituminous roads, the above texts will be found quite complete. For special information on road mix types, ask for Bulletin RM—a group of five selected ones. Oil mat construction is covered in a 20-page pamphlets—OM.

We believe the above booklets, all of which can be obtained for the asking, will also answer that engineer who asked for information on "roads for the county of less than 30,000 population." They will also answer the questions asked regarding the prevention of "washboarding."

Plant Mix

One engineer asks for suggestions as to construction of roads in a county which has no local stone or gravel. North Dakota has used plant mix very successfully, especially the fine-graded type, because crushed stone or gravel suitable for crushing is not available in most sections. Articles on plant-mix have appeared in several issues of PUBLIC WORKS (see especially Nov. 1932, and May, 1934). Mr. J. N. Roherty can probably send sound advice. Address him in care N. D. Highway Dept., Bismarck.

Miscellaneous Data

Several engineers have asked for relative cost data on diesel vs gasoline powered road working equipment. There have been a number of articles on this in PUBLIC WORKS. In general, fuel costs on diesel equipment are not more than one-fourth—often less—as much as gasoline engine driven equipment. We will forward some record data if it is especially requested.

Frost boil prevention is a matter of interest to many engineers in northern areas. The subject was covered quite fully in the April and May, 1934, issues of PUBLIC WORKS, the data being abstracted from a long report of the Bureau of Public Roads, which report was published in full in *Public Roads*.

"How shall I plan extensions to secondary highway system?" is a question which may be answered by another question :"How do I make counts on secondary highways?" An article in PUBLIC WORKS, October, 1934, gave details; and the cement industry has published a very complete booklet on this. Ask for TC. Automatic traffic counters have been described in this magazine from time to time. Names of manufacturers of such equipment will be sent on request.

Three important subjects we shall pass on to our readers for consideration, with an invitation that articles on them be submitted to the editor. They are: "Road Location for Modern Traffic," "Road Cross-Sections for Modern Traffic" and "Getting Rights-of-Way." Has the right of eminent domain failed in the last case? Are state and county highway departments being "held up" for exorbitant prices for rights-of-way necessary to improve alignment, etc.?

The cost of construction by relief forces and methods as compared to costs by contract is, indeed, a touchy subject. We prefer not to express an opinion, at this time. In recent issues we have published articles giving costs by both methods. Some 400 engineers have recently replied to a questionnaire we sent them on the subject giving their own opinions, but the information has not yet been made ready for publishing.

Concrete and Concrete Curing

The proper mixing and curing of concrete bases, and the design, construction and curing of concrete pavements is well covered in a number of booklets which are available on request. For a complete story on this subject ask for group CC, which includes the cement industry publications, and various manuals of 30 to 54 pages. However, there is comparatively little information available on the subject.

Closely connected to this are the unseasonable requests for data on cold weather concrete constructions. Several of the CC group of booklets above cover this, and in addition we shall be glad to send another group of CWC booklets, relating especially to cold weather concreting. A number of articles appeared in this magazine in the late 1934 issues.

Bridge Designing and Construction

Bridge designing is a matter of much interest to many engineers. For those interested in rigid frame concrete arch construction, we can usually supply two RFB bulletins, both excellent in providing a simple analysis of design; those interested in wooden bridges do not have such a good list available. Most of the wood manuals cost real money. However, if engineers desiring such information will write the editor, he will see what can be done. An excellent booklet on concrete bridge details (CBD) is available on request, as is a very fine booklet on beautiful low-cost bridges (ask for BLB) of 48 pages; also several booklets on corrugated pipe culverts (ask for bulletins CU.)

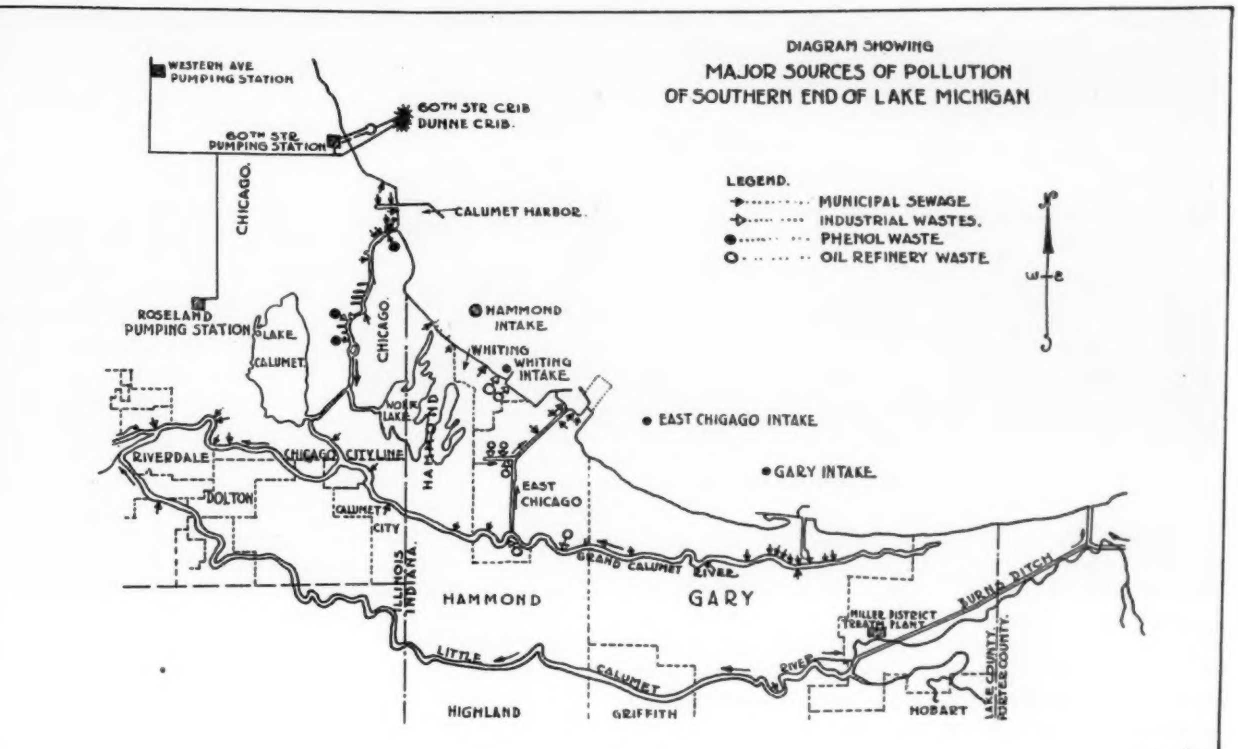


FIG. 1

Major Sources of Pollution of Lake Michigan Near Intake of Hammond Water Supply

New Water Purification Plant at Hammond, Indiana

By Leo Besozzi
Department of Water Works, Hammond, Indiana

THE water supply of Hammond is taken from Lake Michigan at a point about one mile from the shore in a water depth of about 24 feet. This water supply is subject to serious and dangerous pollution and is constantly so polluted. Analyses made by the laboratories of the Chicago Sanitary District from samples of the raw water taken at this point during the month of August 1930, indicated an average B Coli content of 16,000 per 100 c.c.

The major portion of this pollution is caused by the discharging of the raw sewage of the entire north section of Hammond and the City of Whiting, directly into Lake Michigan at a point approximately one-quarter mile east of the present water pumping station. There is also considerable pollution from the industrial wastes of the various large industries situated on both the east and west sides of the pumping plant; the particular area wherein the present water intake of the City of Hammond is located has been determined to be one of the most grossly polluted ones along the entire south shore of Lake Michigan. Considerable pollution also reaches Lake Michigan indirectly through the Little and Grand Calumet rivers and through the Indiana Ship Canal, the water being heavily polluted by the population and industries of the Calumet region, except for such drainage as is carried away through the Sag Canal of the Chicago Sanitary District. In addition to this pollution there are periods when the water is rendered so turbid by storms and wave action upon the accumulated silt deposits along the shore that it is entirely unfit for consumption.

If the cities of Lake County, particularly Hammond, Whiting, East Chicago and Gary, would build sewage treatment plants, a considerable portion of the human sewage pollution would be removed from Lake Michigan. This, however, is not likely to occur in the immediate future and it is the opinion of the writer that dangerous sewage pollution will continue for many years to come. Pollution from shipping is likely to increase rather than decrease, as is also the pollution from the industrial plants located in the region.

Public health has been maintained in Hammond by dosing the water heavily with chlorine, but how long this could continue is a matter of speculation. The industrial wastes carry phenol into Lake Michigan and the necessarily heavy dosing of this water with chlorine gives rise to chlorophenol tastes in the water, rendering it unpalatable at all times. In other words, the City of Hammond has been consuming water that is unsafe, frequently turbid, and at all times unpalatable. Several large industries refused to locate in the city because of the condition of its water supply. Companies furnishing bottled water have been doing a thriving business, as have a large number of deep wells located at various points in the city where citizens may purchase bottled water at exorbitant prices.

Public Health Bulletin No. 170, entitled "Report of an Investigation of the Pollution of Lake Michigan in

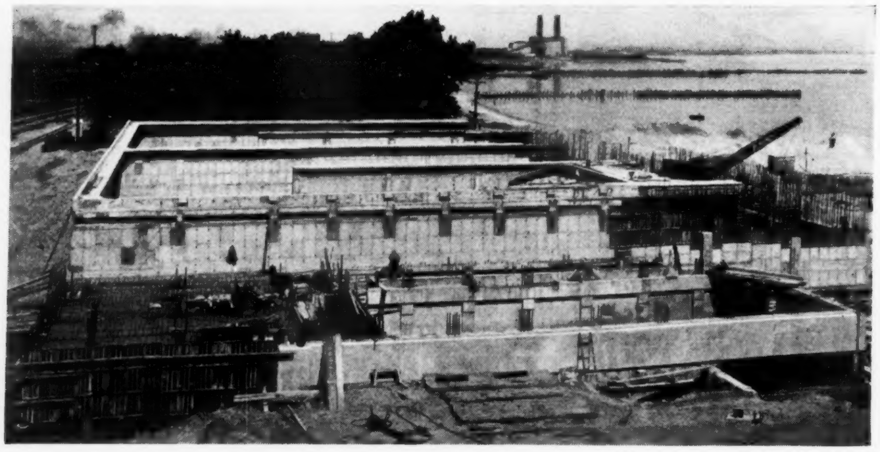


Fig. 2. The Sedimentation Basins and Pump Room

the Vicinity of South Chicago and the Calumet and Indiana Harbors," page 133, states as follows: "The other supplies examined—namely those of Waukegan, Lake Forest, Hammond, Whiting, East Chicago and Gary—all failed to conform to high standards of quality, due in part to excessive pollution of the raw water and in part, in some instances, to the essential inadequacy of the purification processes used. The six supplies are all considered to be too highly polluted for consistently successful purification by chlorination alone, which is the only treatment applied at Waukegan, Hammond and Gary." This report was made in the year 1924-1925, since which time Waukegan has constructed a water filtration plant.

In view of such existing conditions, the City of Hammond, acting through its Department of Water Works, applied in September, 1933, to the PWA for sufficient funds in the form of a loan and grant to construct a 20 M.G.D. Water Filtration Plant.

The preliminary drawings and large amount of data that made up the application for the loan were prepared by the engineers of the Hammond Water Department, acting under the direction of Frank A. Blocker, its chief engineer. In January of 1934 the Federal Government advised the city that the project was being favorably considered, and the Board of Trustees of the Water Department employed the firm of Greeley & Hansen to collaborate and to act as consultants to the Water Department's engineering staff in the preparation of plans and specifications for the project, this work being performed in collaboration with the writer and under the general direction of L. G. Williams, acting as local representative for the consultants.

Description of the Project

The entire project, known as PWA Indiana Project No. 5, consists of a filtration plant with a rated capacity of 20 M.G. per 24 hours, and the construction of shore protection and made land along the shore of Lake Michigan where the plant is located.

The shore protection work consists of a steel sheet piling bulkhead along the shore, together with an embankment to form the site upon which the plant will be located. This site lies between the E. J. & E. Railroad right-of-way and Lake Michigan, upon ground now owned by the City of Hammond and utilized as a city park and bathing beach. Ample space is available for the present plant and its future extension toward the west. All plant substructures are to be constructed of reinforced concrete and all plant superstructures of brick masonry in keeping with existing high-lift pump station buildings. The roof of the reservoir being covered with excavated material, enables the space occupied by it to be used for park purposes.

The plant will draw its water supply through the present city intake pipes and from the present suction well at the city water works, pumping it to two units of four reaction basins equipped with vertical mechanical stirring devices, where the water will be treated with necessary coagulents. Thence it will flow into two "round the end" sedimentation basins, where the major part of the sediment will be removed; thence through eight sand filters of the mechanical gravity type. The filter effluent will enter the clear water storage reservoir and flow through a 42-inch steel pipe to the present pumps of the Hammond city water works, which will deliver it into the distribution system.

The plant has a rated capacity of 20 M.G. per 24 hours at the standard rate of filtration, namely 125 M.G. per acre of filter surface per 24 hours, and will be capable in all its parts of satisfactorily purifying water at an overload of 50% for reasonable periods of time. The capacities of the principal part of the plant are as follows:

Low-lift pumping plant in 4 units, total 64 M.G.D.

Time in reaction basins—30 minutes at rated capacity.

Time in sedimentation basins—4 hours at rated capacity.

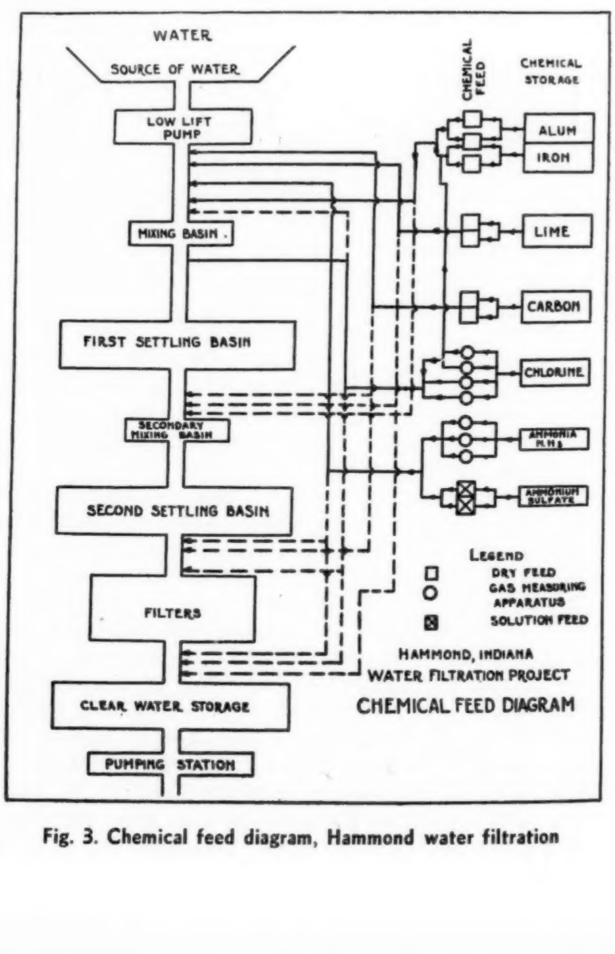


Fig. 3. Chemical feed diagram, Hammond water filtration

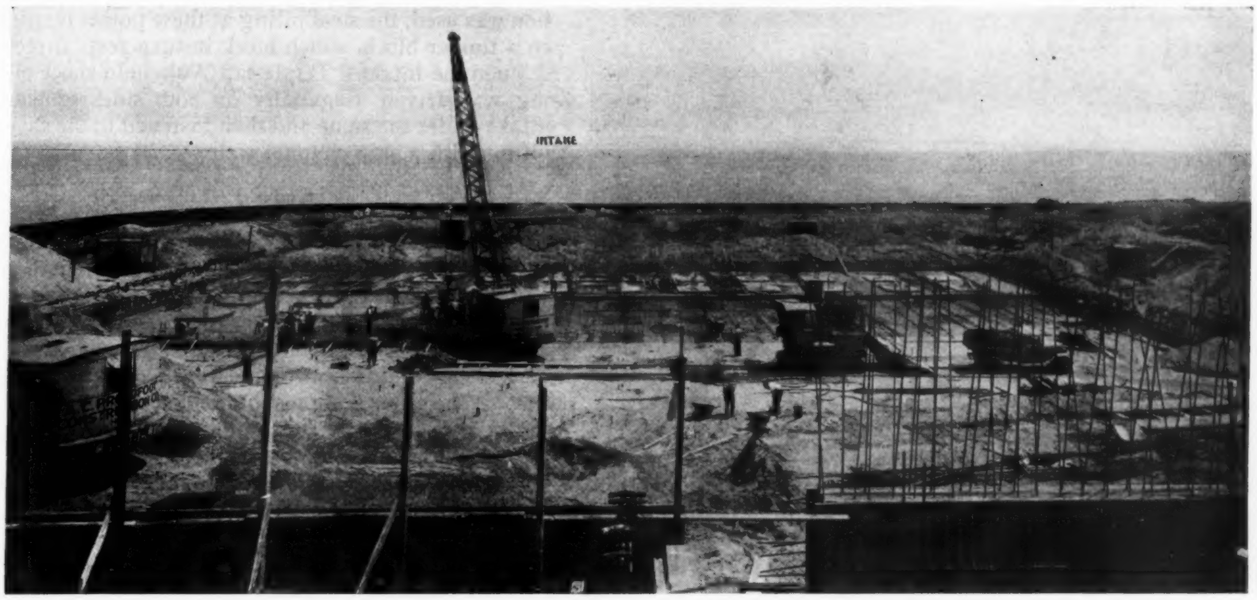


Fig. 4. Pouring the Floor Slab of the Filtered Water Reservoir

Filter beds—8 beds, each with a capacity of 2½ M.G.D.

Clear water storage reservoir—5 M.G.

Pumping Equipment. A low-lift pump room will contain low-lift pumping equipment required to take the water from the present suction well and deliver it to the reaction basins, provisions having been made for applying chemicals in the conduit leading to the reaction basins. This equipment consists of four centrifugal pumps having capacities of 6,950 G.P.M., 12,500 G.P.M., 15,000 G.P.M., and 9,750 G.P.M., respectively, electrically driven by synchronous motors; all pumps, motors and auxiliary equipment being designed so that service can be maintained with any plant unit out of service. A meter and chart recorder are provided, giving the pumpage rate and recording it continuously.

Reaction Basins. The reaction basins are constructed in two units, each unit consisting of four small basins. The mixing period will be 30 minutes, the mixing being performed by vertical mechanical stirring devices, the tanks being so arranged that any unit may operate singly in case of necessity for repairs.

Sedimentation Basins. There are two "round the end" sedimentation basins having a water capacity of four hours' detention period at the rated capacity of the plant, constructed of reinforced concrete. They are so controlled by sluice gates and conduits that either basin can be cut out for cleaning or repairs without interrupting the operation of the plant. The basins may be operated either in series or in parallel, and provision is made for double coagulation.

Filters. The filters are equipped with 4-inch cast-iron underdrains spaced 12 inches on centers, which discharge into a 42-inch concrete manifold located on the underside of the filter box slab in the filtered water reservoir. The filtering material consists of 18 inches of gravel and 30 inches of sand. Six wash-water troughs are provided of sufficient capacity to accommodate a wash-water rise of 42 inches. Ten-inch wall castings provided with blank flanges will be placed in the pipe gallery walls to provide for future installation of either a filter surface wash system or a sub-surface filter system, as future conditions may require. Each filter will be provided with an operating table containing a lever for each of the five filter valves and a loss-of-head and rate-of-flow gauge. All water passages immediately adjacent to the filters are accommodated in a pipe gallery where are installed the hydraulic valves and rate controllers.

Chemical Feed Equipment. Dry feed equipment consists of six units, one for feeding ferrous sulphate, one for alum, two for alum or lime, and two for activated carbon. Each machine is equipped with a solution tank of a relatively large capacity provided with an automatic agitating device and baffles as well as circulating water jets.

There are four chlorine feed machines each having a maximum capacity of 300 pounds of chlorine per twenty-four hours; chlorine being fed from ton containers. There are three ammonia feed machines having a capacity of 100 pounds per twenty-four hours; ammonia being fed from 150-pound cylinders.

Space has also been provided for the future installation of solution feed equipment for sodium aluminate and ammonium sulphate.

The points of applying the several chemicals are shown graphically by Fig. 3. The heavy lines indicate the principal points of feed which are used during the major portion of the time. The broken lines indicate the points to which chemicals are fed for only short periods of time either independently or in conjunction with the full lines.

The plant is so designed that future installation of carbon filters or of an ozone plant is possible.

In the headhouse and over the pump room 2,400 sq. ft. of floor space has been provided for the storage of chemicals and 800 sq. ft. for the storage of chlorine and ammonia containers.

Filtered Water Basin. The filtered water basin has a capacity of 5 million gallons. It will be constructed of reinforced concrete and covered over with 3.5 feet of excavated material taken from the site. A portion of the reservoir underlies and supports the filters, and the balance was designed of flat slab construction of sufficient strength to accommodate a load of 500 pounds per square foot of roof surface. The reservoir is connected to the present high-lift pumps through a 42-inch steel pipe, provided with a control valve. A recording depth

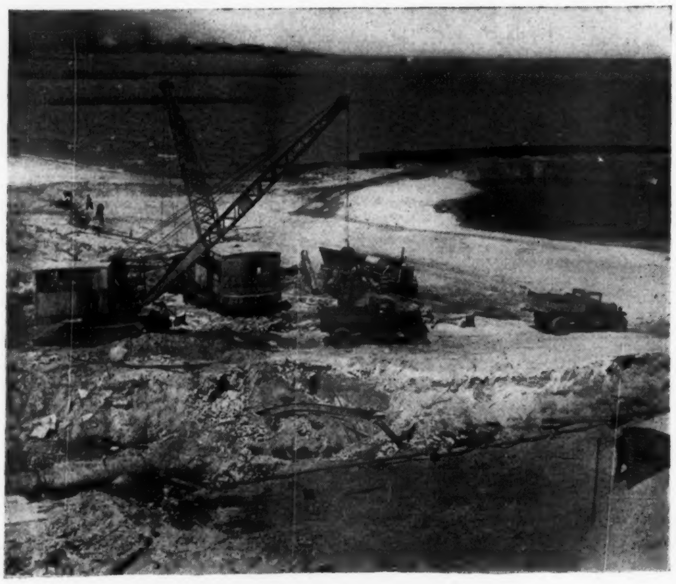


Fig. 5. A View of Construction Work

gauge operating within a range of 20 feet was provided.

Superstructures. All superstructures are of brick masonry and fire proof construction, designed architecturally to be suitable for their location in a park and to harmonize in architectural appearance with the present pumping station. The frames of the superstructures, which house the filters, reaction basins, storage space and pump room are of reinforced concrete, while the frame of the headhouse and housing of the wash-water tank is of steel.

Wash-Water Tank. The plant includes a 100,000 gallon steel wash-water tank, enclosed and located above the headhouse, as an integral part of the headhouse superstructure. The tank is supplied by a 3,000 G.P.M. wash-water pump and is also connected to the high-lift pump station with a 16-inch pressure emergency pipe line. The wash-water tank is equipped with a depth gauge and recorder and a meter to accurately measure the water used for washing the filters.

Shore Protection Work

The shore protection work consists of a single line of steel sheet interlocking arch piles approximately 760 feet long, and an embankment of granulated blast furnace slag. The bulkhead begins about 214 feet from the shore line of Lake Michigan at the west face of an existing pier and runs nearly parallel with the shore line of the lake for a distance of 571 feet. After transversing three cast-iron intake lines (24", 42" and 30") said bulkhead turns shoreward on a circular curve of 80 feet radius. The lake area enclosed by the bulkhead, the present shore line and the existing pier, is filled with approximately 52,000 cubic yards of embankment.

The tops of the steel piles are elevation plus 7.0. The top of the embankment on the shore side of the wall is elevation plus 6.0. The elevation of the water surface is approximately —2.5 and the elevation of the ground line where the piles penetrate it is —7.5. The clay line is elevation —22.0, and the piling penetrates about four feet into this, placing the bottom of the piles at elevation —26.0. A ship channel wale transverses the entire length of the bulkhead on its short side, and tie rods spaced 5′ 4″ on centers anchor the wall to 30-foot timber anchor piles driven on a 30-degree batter. At the intake crossings a somewhat different type of construction was used, the steel piling at these points resting on a timber block, which block in turn rests directly upon the intakes. Triple-lap Wakefield sheet piling was driven diagonally on both sides of each intake under the same and then fastened to the sheet piling with a ship channel wale.

General

Construction on the shore protection work was begun in September, 1934, and was completed by January, 1935. Contracts for the construction of the filtration plant proper have been awarded and construction on plant structures began on March 25th, 1935, and is now under way. Construction on piping and filter equipment and electrical work will begin within a very short time and be well under way at the time of the appearance of this paper.

The entire cost of the project will aggregate $785,000, an estimated breakdown of this cost being set out as follows:

(1)	Steel sheet piling bulkhead	$ 51,254.75
(2)	Embankment	24,000.00
(3)	Plant structures	390,339.00
(4)	Piping and filter equipment	161,934.00
(5)	Gate valves	21,507.40
(6)	Sluice gates	4,631.76
(7)	Pumping equipment	16,160.00
(8)	Electrical work	18,468.00
	Total contract work	$688,294.91
(9)	Preliminary, administrative and legal expense	12,246.56
(10)	Engineering, inspection and materials testing	47,000.00
(11)	Interest during construction	16,000.00
(12)	Contingencies, extra work, etc.	20,000.00
(13)	Miscellaneous items	1,458.53
	Grand Total	$785,000.00

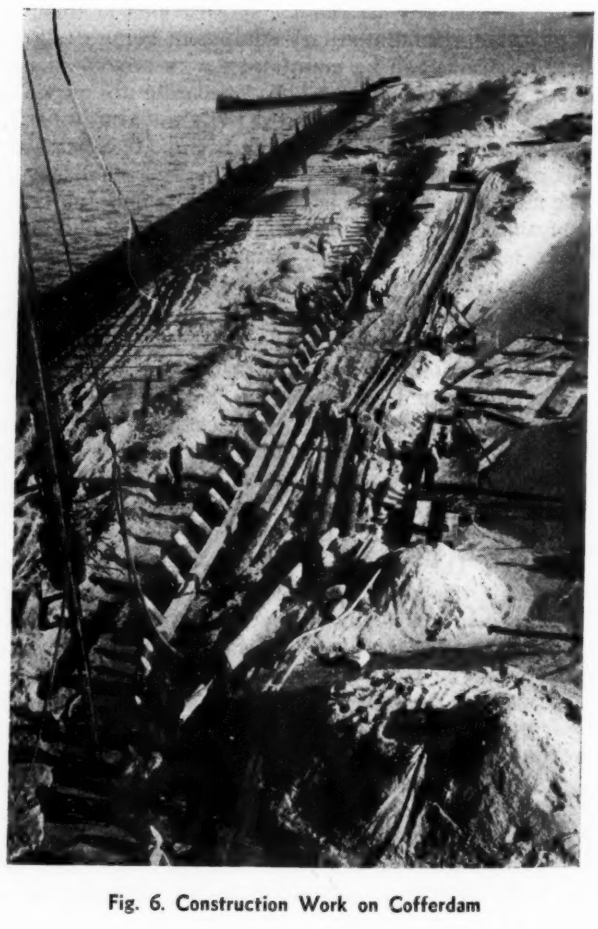
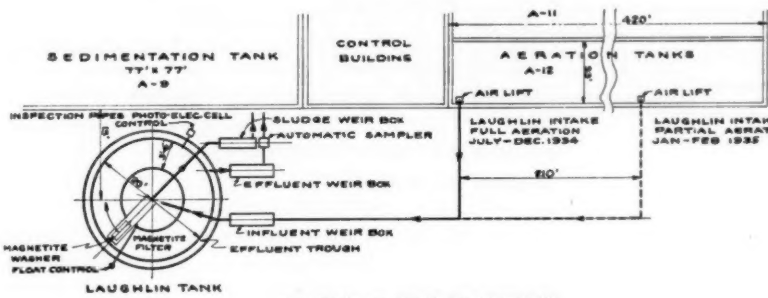


Fig. 6. Construction Work on Cofferdam

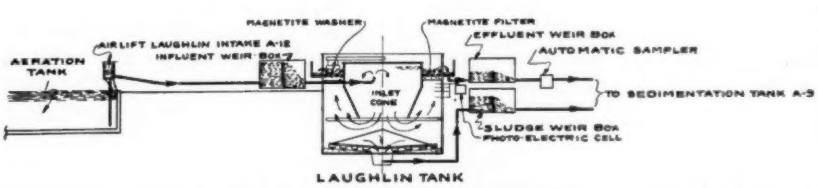
Test of the Laughlin Tank at Chicago

THE Dearborn sewage treatment plant, which has been in service operation for over three years, has as its most unique feature a combined settling tank and upward-flow filter, the latter composed of particles of magnetite which are cleaned by means of a traveling washer consisting of a solenoid which, when over each small section of the bed, raises the particles under it, a pump in the washer meantime drawing through them sewage from below the filter and discharging it back into the tank. (See PUBLIC WORKS for November 1931.)

During about seven months ending in February, 1935, a similar plant was operated and laboratory analyses made by the Sanitary District of Chicago; the Filtration Equipment Corporation (maker of the tank) cooperating in the supervision of the tests, which were conducted for the purpose of determining the applicability and efficiency of the filter when operating on activated sludge aeration tank liquors. The test seems to have been an unusually careful and thorough one.



PLAN-FLOW DIAGRAM



ELEVATION-FLOW DIAGRAM

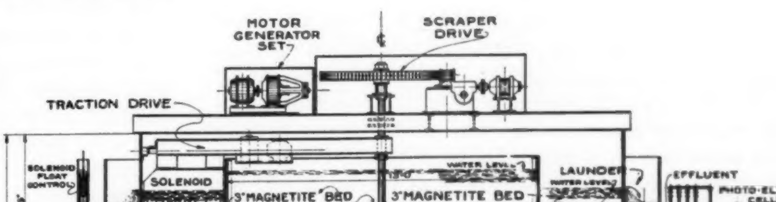
General Layout of Test Plant, North Chicago

The tank handled up to 1.1 mgd of aeration tank liquor. It was operated continuously 24 hrs. a day by the shift force of the Sanitary District. Samples were taken of the effluent at 4 minute intervals, and of the sludge return and wash water hourly; also, occasionally of the liquor 6 in. below the filter, and of the sludge at various depths in the clarifier.

The tank was of steel, 20 ft. diameter, 14 ft. water depth at the side, containing revolving sludge-collecting mechanism. The filter was 3 ft. wide, consisting of a bed of magnetite, from 10 to 20 mesh, 2½ to 3 in. deep, resting on a screen of Everdur metal which was supported by steel bars 2½ in. apart. The washing mechanism was started automatically by means of a float switch whenever the head on the filter increased above a predetermined amount. The wash water was discharged into the settling tank, or into the sludge which was withdrawn—usually the former.

Automatic appliances were used in a number of other places. The 4-minute samples of the effluent were taken with a mechanical sampler. A photo-electric cell and auxiliaries were used for controlling the sludge elevation by opening the motor-driven sludge return valve when the sludge rose above a predetermined point; tank liquid being drawn from this point and flowed over an electric eye, and when this liquid was dirty the valve opened at 7½ minute intervals, while if it was comparatively clear the valve did not open. (The use of the photo-electric cell solved a problem in manual operation in that difficulty was experienced, when using the latter, in preventing the sludge from rising above the filter and affecting the quality of the effluent.) The influent, effluent and withdrawn sludge all passed over weirs and a continuous record was kept of the amount of each by means of Bristol recorders. Powei consumption was recorded by a meter on a continuous chart.

The filter was operated at average rates of 1.4 to 4.2 gal. per sq. ft. per min. and average settling rates of 1410 to 3320 gal. per sq. ft. per 24 hrs. The losses of head in the filter varied from ¼ in. to 2½ in. The amount of filter wash water was estimated to be 3 to 10 percent of the total daily flow to the tank, and the suspended solids in this water varied from 33 to 1100 ppm, normally averaging from 200 to 300 ppm.



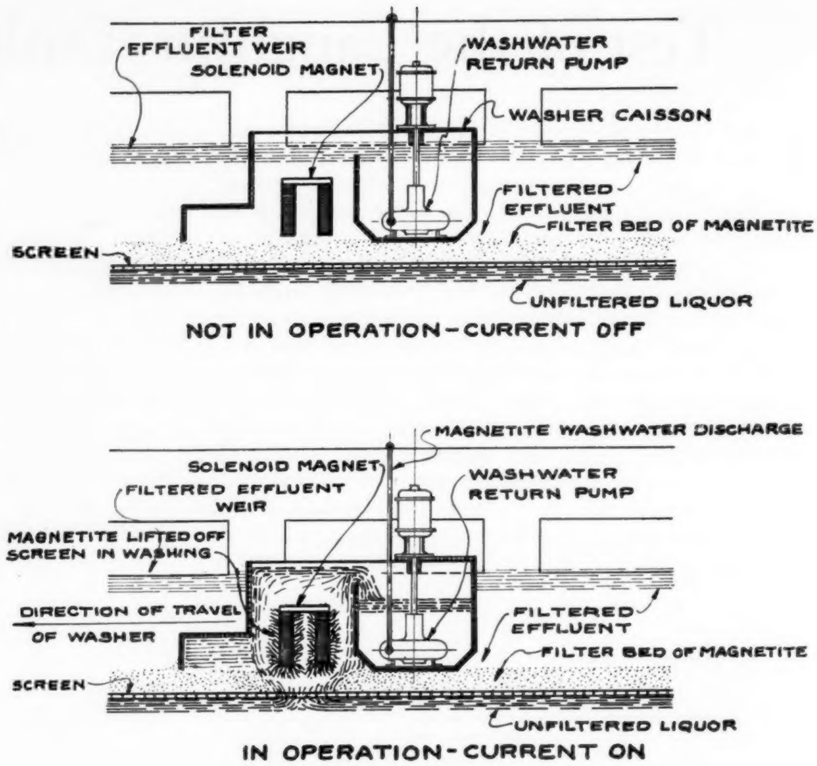
ELEVATION-LAUGHLIN TANK

The effect of the filter was indicated by a comparison of the suspended solids content of the liquor in the tank 6 in. below the filter and of the effluent. When treating fully aerated liquor these averaged 34 ppw and 10 ppm respectively; when the liquor was partially aerated the averages were 35 and 16 ppm.

It was believed that a better sludge concentration would be obtained in a tank having a greater ratio of surface area to depth, and a better filter effluent obtained also.

From a very comprehensive study of the very complete data obtained, it was concluded that, when treating activated sludge liquors under conditions similar to those of the test: (1) The magnetite filter and washer is mechanically adaptable to filtering partially and fully aerated activated sludge liquors. (2) Effluents with 4 to 5 ppm suspended solids and B.O.D. are obtainable for ordinary standard settling rate (1200 gal. per sq. ft. per 24 hrs.) and filter rates of 2 gal. per sq. ft. per min.; and 8 to 10 ppm for settling rates up to 3500 gal. per sq. ft. per 24 hrs. combined with filter rates of about 3.0 gal. per sq. ft. per min. (3) Filter rates of 6 gal. per sq. ft. per min. for short periods, 5 gal. for a period of a day, and averaging 4 gal., are practicable for magnetite filters on activated sludge liquors, but effluents under 15 ppm. B.O.D. or suspended solids can not be expected. (4) Positive removals by the filter of suspended solids up to about 100 ppm on individual days and averaging 20 to 25 ppm over a period are possible. (5) Loss of head through the filter bed is not excessive, normally reaching a maximum equivalent to 3 inches of water. (6) The filter can be designed to provide protective features acting as a safety valve to counteract underactivation, poor settling conditions or bulking sludge.

The above is condensed from a paper by S. I. Zack, sanitary engineer of the Filtration Equipment Corp., before the New York State Sewage Works Assn. and published in Sewage Works Journal, to which we are indebted for the illustrations.



Details of the Magnetite Washer

A Creosote Timber Rock-Filled Dam

In many mid-west cities, the drouth of the past few years has led to the construction of additional storage facilities. A creosoted timber rock-filled dam being built by the city of Osborne, Kansas, on the south fork of the Solomon River, to impound added water for the city is described in a recent issue of Wood Preserving News. The bottom of the stream is at elevation 80; the overflow section, which has a length of 425 feet, is at elevation 95. The area of the lake formed by the dam is 80 acres.

The overflow section is constructed with creosoted Wakefield sheet piling and riprapped wings, the total top length being 610 feet. The elevation of the nonspillway section is 105. Seepage across the stream channel is shut off by wood sheet piling, untreated by reason of permanent saturation. A core is formed by backfilling a trench with selected earth consolidated by puddling and rolling. Beginning on the crest of the dam, the downstream face is protected by rock-filled cribs 10 ft. square formed by creosoted piles driven at 10-ft. centers in parallel rows 10 ft. apart. These piles are braced transversely with 4 x 8-in. x 12-ft. timbers and longitudinally with 3 x 12-in. plank. Wrought iron bolts and washers are specified. The tops of the piles and plank are set flush with the slope of the finished surface. The cribs formed by the piles and braces are filled with limestone rock, graded and tamped to maximum density, in which 10 per cent of the pieces weigh at least 1,000 lbs. The downstream surface is then finished by placing rock riprap over the entire face, each rock being 2 ft. long and placed on end perpendicular to the slope. The stream bed below the dam, the slopes at the ends, and the upstream face are riprapped in a similar manner.

The concrete intake and outlet box are supported on a timber pile foundation.

The structure contains 27,500 bd. ft. of Wakefield sheet piling, 13,500 bd. ft. of timber bracing and 4,420 lin. ft. of round piles pressure treated by an empty-cell process to retain 10 lbs. of Grade One coal-tar creosote per cubic foot of wood. Field cuts are treated with three coats of hot creosote and sealing compound.

This work was designed for the city of Osborne as a relief project by the Wilson Engineering Company of Salina, Kansas.

The Editor's Page

Experiments in Sanitation and Health

Every hundred or perhaps two hundred miles apart throughout the country transient camps have been built by Uncle Sam to reduce the migrant population, including the "weary willies" of former days. Here the transients find a home, food and clothing. Many of these "camps" are really hotels, housing 250 or more men. Generally they are located outside of city limits, and must therefore have a sewage disposal system of their own.

Haste and false economy marked the construction of most of these treatment plants. Money was available for many other items, but for sewage treatment the iron hand of economy ruled. An inadequate septic tank and some sort of makeshift disposal field was the general result of grasping at economy straws. As any sanitary engineer would expect, the outcome has been nuisance, trouble and added expense for patching and improvisations to make the original misfit last a little longer.

In general, the same result—disgraceful failure—has been very successfully achieved with the some 1,300 CCC camps scattered throughout the country. Whether due to lack of real knowledge on the part of those charged with this phase of the work, or whether because of the original limited appropriations, the result has been discomfort on the part of the users of these facilities—if they can be called such—a general nuisance to the community in which they are located, a menace to health, and a continual drag on the bankroll.

Competent engineers to handle both of these jobs could have been mobilized within a week. The result would have been an actual saving in money to date, comfortable and sanitary installations and real health protection.

The writer of these lines has been waging a sort of one-man war against these conditions, especially those pertaining to the CCC. Net results to date have been the addition of two or three very well qualified sanitary engineers, and promises for the addition of more. The horses have been pretty well stolen already, but a mule or two may be saved if the barn doors are locked promptly.

The Best, Safest, Most Permanent and Economical Type of Dam

"Earth dams are the oldest, the best, the safest, the most permanent and, under conditions as here exist, the most economical that have ever been devised. . . . No earth dam of this type properly designed and built has failed after the reservoir has been constructed and filled with water, except in very rare instances where the water overtopped the dam due to deficient spillway capacity."

This is the opinion of three engineers of national reputation—Robert Ridgeway, J. Waldo Smith and Frank E. Winsor—as contained in a report to the Hartford, Conn., Water Bureau on the proposed Bills Brook dam (now under construction). It is certainly high commendation from high authorities. But it is most important that the qualifying clauses be not overlooked—"under conditions as here exist," "of this type, properly designed and built," and "deficient spillway capacity."

The consultants undoubtedly had in mind, in making this report, the certainty that, with Caleb Mills Saville in charge, the dam *would* be "properly designed and built" and would not have "deficient spillway capacity." Too often earth dams (especially small ones) are treated as merely a pile of dirt, and the spillway capacity is fixed by guess. What may result from such non-engineering treatment of a small earth dam was demonstrated by the Johnstown flood. Preparation for the Bills Brook dam was most thorough. Rainfall records were investigated. Complete tests were made on a 1:30 size model of the proposed spillway and discharge channel (incidentally suggesting changes that more than offset the entire cost of the tests); test pits were dug; the underlying rock was drilled and grouted; two engineers and two geologists of national reputation were consulted. In fact, the report quoted above said: "We are impressed with the mass of detailed information you have gathered."

Under such conditions an earth dam may be the "best, safest, most permanent type." But on the other hand, of no type is it more true that it is "better to be safe than be sorry."

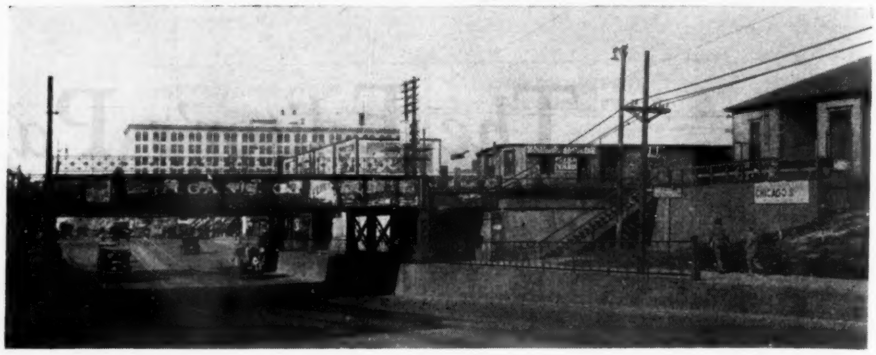
The Answer Remains the Same

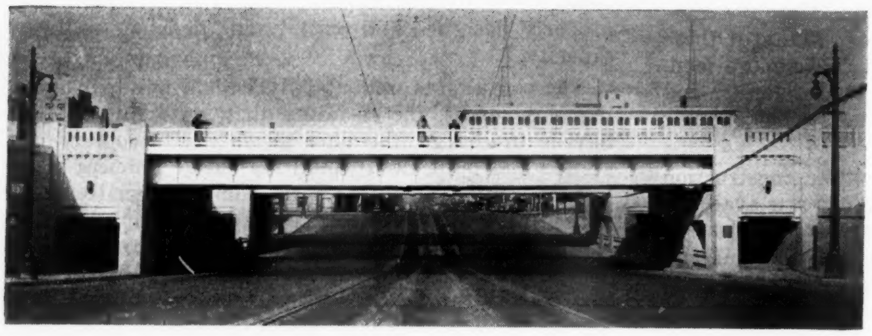
Changes in rules and regulations covering the expenditure of that slowly moving four billion have been made, so that the public works industry is no longer confronted in all cases with the limitation of $1,400 per man—in the highway field, for instance.

But these changes do not in any way alter or affect the fundamental factors: Men must be put to work, and through their labor they must produce structures of value and ultimate profit to the community. There is no other formula for finding our way out of the depression. Moreover, these structures must be conceived and built with the realization that they will fail their purpose unless they serve during future years at a low maintenance and operating cost. Hasty and careless construction of unsound or worthless projects will result in heavy costs to the communities in the years to come. Sound construction of needed projects will contribute to prosperity, better living and better health, with a reduced burden for future upkeep and operation.

This means, in sequence, sound engineering concepts, first rate planning and design, and proper construction, using common sense in the employment of needed materials and equipment. Pick and shovel work will no more accomplish these ends than the much-criticized raking of leaves.

Right: Old Grade Separation Structure Built in 1900
Below: The New Structure Just Completed





By G. C. Richards

Project Engineer in charge of Woodward Avenue Grade Separation

Street Widening and Grade Separation in Detroit

ONE of the outstanding projects being built in Michigan under the National Industrial Recovery Act is the widening of Woodward Avenue in Detroit, NRM 258, at an estimated construction cost of $1,500,000. During 1934, $250,000 was spent in street work and $400,000 on a grade separation where the Grand Trunk Western and the Michigan Central Railroads cross Woodward Avenue.

US-10, a 204-foot super -highway leading into Detroit, carries as many as 42,000 cars in twenty-four hours, the greatest traffic load of any highway in Michigan. The "Master Plan of Detroit", prepared in 1929, after an exhaustive study of the city's traffic problems, verifies the decision formerly made by the State that Woodward Avenue is the logical street to carry this traffic through the city.

The project was made possible by the cooperation of the Federal Government with the local agencies. The State Highway Department and the City of Detroit participated in the cost of right-of-way purchases and damage awards. The paving and grade separation costs were paid from the National Highway Grant. The design and construction was under the direct supervision of the State Highway Department and the Bureau of Public Roads.

Because Woodward Avenue was a very busy street, lined on both sides with store buildings, some several stories in height, the widening, which meant moving, or tearing down, most of these buildings and tearing up the street in general, was quite an undertaking. The project extended from Adams Avenue to the Grand Boulevard, a distance of 2.53 miles. The new concrete-base asphalt-top pavement with a brick parking strip on each side was 90 ft. wide, and the sidewalks 15 ft. each.

The grade separation in connection with the widening was one of the first projects to be built under the National Highway Grant. Grade separation construction being of particular interest at this time, this article will describe this part of the Woodward Widening Project.

The structures which were replaced consisted of two separate bridges, one carrying three tracks of the Michigan Central Railroad and the other carrying two tracks of the Grand Trunk Western Railroad. These structures were of the same through girder type with steel sidewalk, piers, and gravity type concrete abutments. The two structures were separated by fifty-five feet although the pier footings were connected. This grade separation was the oldest in the State.

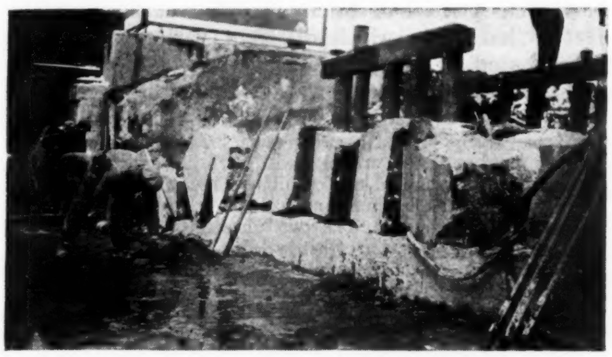
As the Federal Government was very anxious to employ men as soon as possible, it was decided to let the Railroads do the track and trestle work, since this would speed up the beginning of actual construction on the general contract, and this work was started soon after the approval of the project by the Bureau of Public Roads. The Highway Department, therefore, was able to start the general grade separation contract as soon as plans were completed and bids taken.

The soil around Detroit varies considerably and it was, therefore, necessary to make thorough soil analyses at the bridge location. Borings and tests to a depth of forty feet below the street level showed the soil to consist of blue clay which increased in plasticity as the depth increased. A machine for determining quite accurately the bearing capacity of soil, has been designed and used by the research consultant of the Department in the Detroit area. Tests made with this machine showed that a safe bearing pressure of 4000 pounds per square foot was allowable. Because of the plastic clay soil in

this locality, a spread footing has proven in other structures to be the most satisfactory, and was, after other tests had been made, recommended for the abutments.

Many features of design had to be discussed and agreed upon by the Bureau of Public Roads, the State of Michigan, the City of Detroit and the two railroads involved. Since Woodward Avenue is one of the principal entrance routes of the city, plans have been made to beautify abutting property and buildings. In line with this policy, the bridge was designed not only from a practical engineering view point, but also to make the completed structure of pleasing appearance and harmonize with future developments.

As it was highly desirable not to have a center pier, a clear opening of 90 feet was necessary between curbs to clear the street. A through girder type bridge was finally decided upon, which meant spreading the railroad track centers, raising the track grade, and lowering the pavement. These features were undesirable, but the advantages outweighed the disadvantages. A pair of girders 95 feet long, 8 feet back to back of angles and weighing 60 tons each were designed for each track. The



Concrete Broken With Hydraulic Cartridge

deck was designed of I-beams incased in concrete and having a mastic protective covering. The abutments were of box type design having the sidewalks running through them. The deck load was carried directly to the footings by steel H columns which were incased in concrete columns. The lines were very modernistic, as the accompanying illustrations will show.

Because of the great amount of street car and automobile traffic on Woodward Avenue, it was desirable to keep as much of the street open during construction as possible. A temporary trestle for the railroad tracks would mean closing the street to automobile traffic. The idea was conceived by the Michigan Central Railroad engineers to move their existing three-track steel bridge north fifty feet and locate it between the Michigan Central and the Grand Trunk Western Railroads' permanent tracks so that this bridge could be used for the runaround for both railroads. The railroad traffic was very heavy at this time, and it was desirable to roll the bridge to its new location in the shortest time possible. The D. W. Thurston Company contracted to move the bridge and build a trestle.

The old superstructure consisted of 5-foot steel girders with steel cross beams incased in concrete. The substructure consisted of gravity-type abutments and steel column sidewalk piers. Rolling bents were built close to the steel columns of the old bridge and steel rail placed on top of the cap. Jacking columns and jacks were placed under the girders in readiness to raise the bridge. Four-inch steel rollers and rolling plates were ready to be placed as soon as the bridge was raised. Cables were attached to the bridge and carried through blocks to a locomotive crane. The cable was so regulated that the movement of the bridge could be absolutely controlled. A temporary route was arranged so that, should there be some trouble in moving the bridge, traffic could be re-routed, but this would mean extra expense and loss of time to the railroads and so would be very undesirable.

Orders were issued that there was to be one hour between trains at the time set for moving the bridge. As soon as the last train had passed over the bridge, tracks were cut and jacking was started. Everything was well arranged by the contractor, and in twenty-seven minutes the bridge had been rolled fifty feet, let down in place and tracks connected ready for traffic. This was a record in this section for rolling bridges.

Street car and automobile traffic were kept in operation throughout most of the job at a big saving to the city of Detroit and the riding public.

The use of dynamite was prohibited in the removal of old abutments and walls because of the nearness to large buildings, and a method of breaking concrete was used which was new to this section of the country for this kind of work and proved very satisfactory. A concrete breaker known as the "hydraulic cartridge" was used. It consisted of a cylinder connected to a piece of $\frac{3}{4}''$ pipe with a $\frac{1}{4}''$ opening. A hand pump and pressure screw were attached to the end of the pipe. Four 3-inch pistons were fitted into the side of the cylinder. Holes were drilled in the concrete on 3-foot centers, using a special imported rock drill. The cylinder was placed in a hole and water pumped into the cylinder, and great pressure was then transferred to the water by the screw, and by the water to the pistons, which were pushed out against the concrete, causing it to crack. The concrete was thus broken up in about cubic yard pieces and loaded on flat cars by locomotive crane.

The D. W. Thurston Company (now the W. H. Storen Company) was the contractor on the new structure. This contractor has specialized for years in grade separation work, and the speed and ability with which he

Top—Old Bridge, Showing Roller Bents
Bottom—New 60-Ton Girders Being Erected. (Also Old Bridge Used as a Runaround)

carried out the job to an early completion proved that a specialist in grade separation work is more satisfactory than a general contractor.

The equipment was particularly suited to do the job. Four 30-ton locomotive cranes were used and proved very necessary to the job. Two 27E paving mixers and two 36-yard Butler material bins and scales were used for preparing the concrete. Aggregates were handled directly from the cars to the bins and cement from the cars to the mixer. Stock piles were kept on hand for emergencies. Two complete concrete plants were set up, one on the northwest corner of the job, and one on the southwest corner, both at track level behind the abutments. Work could thus progress on both sides of the street at the same time, which proved very advantageous. By using one-yard bottom-dump buckets, all concrete was placed by means of locomotive cranes.

The erection of the 60-ton girders was particularly well carried out. Special short booms were purchased for two of the cranes. The girder was placed on a single flat car and rolled onto the temporary bridge adjacent to the new location. A locomotive crane was then placed at each end of the girder and its cable fastened to the adjacent end, and by careful manipulation the girders were all placed without any difficulty.

The "mortar void" method of design and control of concrete mixtures was used, as this method has proven most satisfactory to the Highway Department. The strength of the concrete is pre-determined, fixing the water-cement ratio as a constant. Proportioning charts are made up by the Research and Testing Department after tests have been made in the laboratory of the particular material to be used in the mix. The desired consistency of the concrete may be selected from the chart to meet the particular conditions, i.e., amount of steel, size and shape of pour, method of placing and working of concrete.

The concrete plant inspector on the job is equipped with the necessary equipment to determine the weight and moisture content of the aggregate. In computing the mix, the weight and moisture content of a cubic foot of bone-dry loose coarse aggregate are determined. From these determinations the weight of each ingredient is read directly from the proportioning chart for a one sack batch. Correction for moisture and the desired sack batch is then determined.

The form work was especially good on this job. As vibrators were required by specifications, the forms were built to take care of extra stresses. They were built in panels of ¾" shiplap, lined with ⅜" plywood. Studs were spaced on 12-inch centers, and wales on 3-foot centers. The use of plywood facing was new to this state and proved very satisfactory since its use eliminated most of the board marks which usually make concrete unsightly. Each panel could be used several times if they were removed carefully. The cost of the forms was a little higher than in the past but the saving in rubbing off-set the extra cost.

In conclusion, there are several things which stand out in the constructions of this grade separation: The speed with which the project was started after approval was granted by the Bureau of Public Roads; the fine cooperation received from the railroads involved and the City of Detroit; the desirability of awarding contracts to contractors who have the experience, organization and equipment to carry out and complete the work satisfactorily; and the fine cooperation between labor and the contractor with little hardship to either under rules and regulations of the Bureau of Public Roads under the National Industrial Recovery Act.

All highway construction and maintenance in the State of Michigan is under the direct control of State Highway Commissioner Van Wagoner. The bridge and grade separation construction and maintenance are under the supervision of L. W. Millard, bridge engineer. J. H. Cissel, engineer of bridge design, and J. H. Flynn, engineer of bridge construction, have direct charge of bridge and grade separation design and construction respectively. G. C. Richards was project engineer in charge of the Woodward Avenue Grade Separation.

Fillers For Brick Pavements

The new types of fillers for use in brick pavement construction developed in the Laboratory of the Research Bureau of the National Paving Brick Association at the Ohio State University Experiment Station will be tested in actual service in a brick pavement now being constructed under the supervision of the U. S. Bureau of Public Roads and the Ohio Highway Department on Ohio Route No. 31, the Columbus-Athens Road in Hocking and Fairfield Counties. There will be fifteen sections of brick pavement each about 500 feet in length in which different varieties of fillers will be used. Following is an outline of the tests that will be made and the observations that will be recorded:

1. Exuding of filler.
2. A comparison of traffic effect on a brick surface course. A large number of coal trucks loaded with five tons or more use this road to haul coal to Columbus. These trucks travel light going south to the mines and use the other lane going north when they are loaded. The two lanes can easily be analyzed to determine the effect of heavy loads.
3. Temperature gradient through brick-cushion-base and subgrade and a determination of the protective effect of brick surface courses on a concrete base. No factual information is available on the temperature gradient through the various parts of a brick road.
4. Tractive resistance of motor vehicles on brick surfaces as related to the amount of exuded filler. This will be a continuation of an investigation by Professors Stinson and Roberts of the Mechanical Engineering Department of Ohio State University as reported to the Highway Research Board.
5. Determination of whether separating agents affect the adhesion of the filler material in the joints. In connection with the use of "plastic sulfur" a new separating agent (an oil-water emulsion) will be tried. Data relative to the effectiveness and cost of using this material will be obtained.
6. A study of the moisture-proof qualities of a surface course of brick.
7. A record will be kept of the temperature of the heating kettle and occasionally of the temperature of the filler as poured from buckets. The surface of the filler will be chilled with water at several points and the effect of shrinkage in the joints on exuding noted. At various points brick will be removed from the finished pavement to note the penetration of filler in the joints.

In addition to those listed above, it is proposed to devise a test to determine the amount of stress and impact that is absorbed by a brick surface course. The details of this test have not yet been fully worked out and it will be performed first in the laboratory on brick pavement panels.

Crown in Stabilized Roads

The effect of crown on the service behavior of stabilized gravel roads has been investigated by Fred Burggraf, materials engineer for the Calcium Chloride Association, and a summary of conclusions drawn from investigations made on numerous stabilized gravel roads in Kansas, Illinois, Missouri and Indiana, has been prepared. A definite relation between the amount of crown and the service behavior of the roads is established by the data presented. The results show that the minimum desirable crown is three-eighths inch per foot of width. A brief history of crown formulas and a discussion of several types of crown is also included.

Difficult Sewer Construction by Force Account

By Olney Borden
Project Engineer, Sullivan County EWB

THE largest relief project in Sullivan County, New York, other than highway work, has been the construction of sewer lines in the village of Roscoe. At the present time, the work is being carried on as a T.E.R.A. project started Oct. 5, 1934. The construction of a small sewage treatment plant, with a capacity of 90,000 gallons per day, is contemplated and approval for this project is now being sought under the Works Progress Administration.

The Roscoe work is of considerable interest in that it offered many difficulties in construction, that it provided work for the town unemployed throughout the entire very cold winter of 1934-5, and that accurate cost records of the work were kept. An average force of just over 20 men was employed; the hours of labor were kept to 24 per week; and the rate of pay was 30 cents an hour.

Starting on Oct. 5, an 8-inch line was run from the Willowemoc river (into which the plant effluent will be discharged), along the railroad, to the business section of the village. This involved the construction of about 1,250 feet of line, of which 710 feet required trenching from 14 to 17 feet in depth. Moreover, the line ran between the railroad and a high bank for a considerable distance and for 150 feet between the railroad and a milk plant. In the first section, there was no easy method for disposing of the dirt taken out of the trench, and much of it had to be handled six times; along the milk plant, excavation had to be wheeled from 125 to 200 feet, piled, and then wheeled back for filling.

The material through which the excavation was made was a running gravel, requiring tight sheeting. Boulders of all sizes were found. Blasting was not possible, and the larger stones had to be cut through; in places the material was nothing more than a deposit of large and small boulders, filled with sand, removal of which was very difficult and slow. These conditions also interfered with sheeting. In most cases the sheeting had to be underdug and then driven down.

All this work was done during the winter, and in close proximity to the northbound track of the N. Y. O. & W. Railway, which carries a heavy coal traffic. Despite these conditions, not a single man lost a day's pay because of accident. A light railing was maintained between the track and the excavation and no worker was allowed outside this railing.

Ground water was encountered from one to two feet above the sewer grade, with a running sand, which made laying difficult. Bituminous type sewer joints were used and considerable care taken in laying; and even with the ground water and though the pipe also crossed 2 feet under a brook, the leakage on the 1,250 feet of line was not sufficient to produce a measurable discharge at the outlet. This brook, by the way, presented another difficult problem because it was carried in a culvert and had to be crossed at a point close to the railroad tracks and in a 10-foot cut.

Complete plans provide for approximately 10,000 feet of 8 and 6-inch pipe; of this, 3,896 feet have been laid and about 3,000 feet more will be laid now. The costs, up to July 18 last, for the 3,896 feet have totalled $9,559.82 for all materials and labor, including the construction of 14 manholes, engineering, legal, etc. Of this sum, the T. E. R. A. has contributed $5,887.13, or 61% of the total.

The labor costs on the construction of the sewer lines have been as follows:

850 ft. average depth 4½ feet................ 70c per foot
2266 ft. average depth 6 feet................ 83c per foot
70 ft. average depth 8 feet................$2.17 per foot
710 ft. average depth 14 feet................ 6.16 per foot

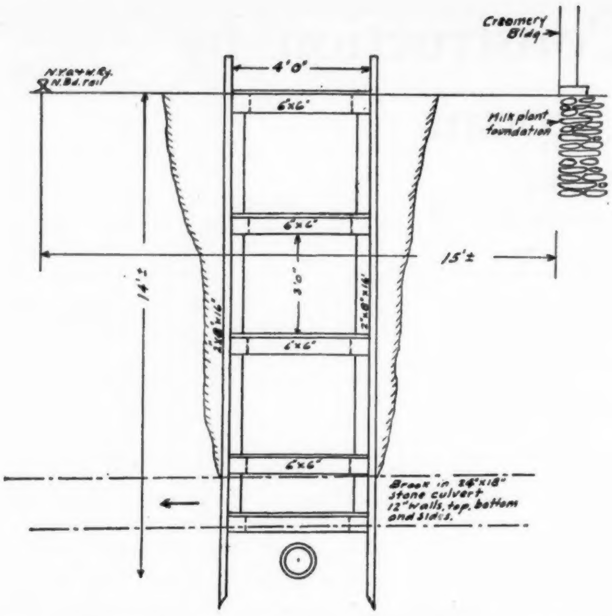
The labor costs on manholes were as follows:

1 manhole, depth 17 feet......................$75.00
2 manholes, depth 12 feet........................ 50.00 each
11 manholes, average depth 5½ feet.............. 21.50 each

All trenches over 6 feet deep were sheeted, and some sheeting was necessary in poor soil when the depth was not so great. On the deeper sections, 2 x 8 sheeting was used, with 6 x 6 walers spaced 3 feet vertically. Using care in driving, the sheeting could be used several times, despite the difficult conditions already mentioned.

In passing the milk plant, a trench averaging 12 to 13 feet in depth had to be carried within 3 feet of the plant foundations. A spell of unusually cold weather,

Upper left, trench along milk plant. Guard rail and tracks discernible at left. Upper right, going into the deep cut. Below, pumps were needed much of the time. Excavated material shows "better than average" going.



Cross section through 14 ft. trench at creamery. Areas shown hatched in outline caved as piling was undercut and were back-filled with earth to prevent further caving.

which froze the ground to a depth of 4½ feet—well below the foundation levels—was a great help in supporting these old stone foundations, so that no trouble was encountered in this rather ticklish stage of the work.

Nearly all of the remaining trenching is comparatively easy, as compared to that already dug, and no further difficulties are anticipated in trench construction. Aside from one or two blocks, the depth will average around 5 feet, and much of it will be above ground water—nearly all in fact.

Work will start on the sewage plant in the near future, and it is planned to complete this before winter sets in. This plant involves many interesting features, due to the necessity for protecting it against high water and to the fact that economical, but continuous, operation is necessary.

It is felt that a considerable saving has been accomplished by the use of relief workers, most of whom are small farmers or farm workers, general handy men, etc. Direct relief would have been necessary if work relief had not been provided. By employing these men on this work, the Sewer District has carried the relief load for the entire town, while securing construction that could not otherwise have been done for the amount of local money spent.

F. T. Griswold of Roscoe is Town Supervisor and chairman of the Board of Trustees of the Roscoe Sewer District. In this capacity he has had general responsibility for the work done, both in regard to administrative details connected with construction, and also in relation to relief work. The plans for the sewer system and for the treatment plant were prepared by W. A. Hardenbergh; the writer has had general supervision of the work.

Vulcanized Rubber for Pipe Protection

Vulcanized rubber applied to pipe to protect it against corrosion and soil stress is being tried in an experiment conducted by gas and rubber companies. A section of 100 ft. of pipe covered with a one-fourth-inch thick coating of vulcanized rubber has been laid in soil where corrosion has been especially severe.

Activated Carbon for Activated Sludge Plants

What is believed to be the first test of the use of activated carbon in commercial sewage treatment which has been carried to completion was begun in February, 1935, in the activated sludge plant at Newark, N. Y.

The carbon ("Nuchar," furnished through the courtesy of the Industrial Chemical Sales Co.) was applied at the rate of 35 pounds a day, split into two portions. (The population contributing sewage is about 9,000.) The feeding machine consists of a barrel with a ¾" pipe leading out 4" from the top, water being fed in at the bottom by means of a hose.

In May the chief operator of the plant, T. J. Smith, reported that the treatment had reduced the hydrogen sulphide odor (which had been present at times in the raw sewage); reduced scum formation at least 75%; noticeably decreased the quantity of grease separating out in the aeration channels; increased the gas production about 25% and increased the methane content; produced no apparent chemical or physical change in the effluent.

June 24th the first sludge was drawn subsequent to the beginning of the carbon treatment. About 50,000 gals. was drawn onto the drying beds and "dewatered the fastest of any sludge that was ever placed on the beds," said Mr. Smith. "It was entirely free from odor; any digested sludge has a strong ammonia odor, but this sludge did not. It is black in color, cracking very fast." Analysis of this sludge showed 3.92% solids and 66.0% ash; 7.2 pH. Sludge untreated with carbon showed 1.78% solids, 30.6% ash; 7.1 pH.

Some of the carbon is carried through the primary settling tanks and gives a darker color to the activated sludge but seems to have no effect on the floc-forming tendencies, clarification, or settling in the final tanks.

Both quantity and quality of gas has improved. The former has increased from 6,000 or 7,000 cu. ft. per day to between 9,000 and 10,000. As to quality, the gas engine required 100 cu. ft. of gas less per hour than before the carbon was used (317 cu. ft. as against more than 400). The B T U is 682. Besides being used in the gas engine, providing power for compressing all the air required for the activated sludge end of the plant, in winter it supplies all the heat required for heating the digestion tank and part of the plant.

Lubricating Construction Equipment on a Large Job

Proper lubrication is a vital part of maintaining construction equipment in good shape, and in preventing rapid depreciation, and costly delays. The method adopted by the List and Clark Co., contractors, as described by C. E. Clark, vice-president, is:

"Our superintendent, working with the Alemite Co. representative, built a lubricating outfit, which was mounted on a 1½-ton truck. This lubricating outfit consisted of an Alemite power Lubrigun, a small compressor operated by a gasoline engine, an electric light plant, oil barrels containing different grades of oil, and a storage tank for lubricant. With this outfit we have been able to lubricate all of our construction machinery at night, and also to do a much better job."

This method described by Mr. Clark has other advantages, a chief one of which is that it prevents the exposure of the grease and its contamination with grit. Also, centering the responsibility for proper lubrication results in fewer failures due to neglect or careless work.

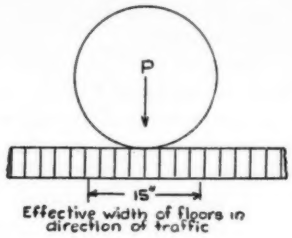


Fig. 1

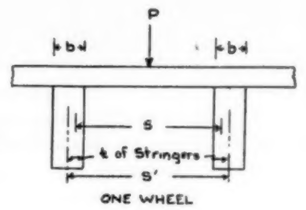


Fig. 2

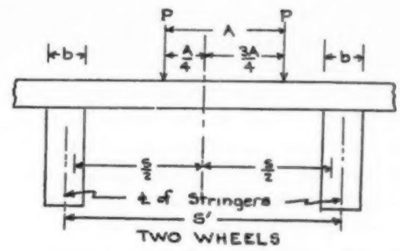


Fig. 3

The Design of Laminated Timber Bridge Floors

IN designing bridges, three different weights of trucks are commonly used—the 20-ton, the 15-ton and the 10-ton. Each rear wheel is considered as carrying 40% of the total truck load. Bridge floors need replacement from time to time. The following material on bridge floor design was arranged by W. A. Stacey, of the American Wood Preservers' Ass'n., and was published in a recent issue of Wood Preserving News.

From a memorandum of the Bureau of Public Roads, covering the design of laminated timber bridge floors wherein the pieces are transverse to the director of traffic, the following is excerpted:

Wheel load considered to be distributed over 15" width of floor when the laminations are fastened together and to the stringers by nails or others connectors giving results equivalent to the following: "Each lamination to be fastened to the adjacent piece by spikes of sufficient length to pass through two strips and at least half way through the third, and spaced at 18" c. to c., staggered 6" in adjacent pieces. Each piece of flooring to be toe-nailed to alternate stringers with 20d or 30d nails, and adjacent laminations to be nailed to other alternate stringers. Each end of all pieces shall be fastened to the stringer with one nail and to the preceding piece by one horizontal nail."

Stringer spacing to equal effective span plus one-half the width of the stringer flange.

Effective span lengths for 8/10 M (M= Simple span moment) may be used for laminated floors under the following restrictions:

(1) Not more than 34 per cent of floor pieces shall be less than full length.

(2) Each piece shall be of sufficient length to bear on at least three stringers.

(3) Generally splices shall be made on the center line of a stringer. Each end shall be fastened to the stringer with one toe nail and to the preceding lamina with one horizontal nail.

(4) Each spliced lamina shall be followed by at least two full length laminae.

(5) Splices shall not occur oftener than once in two feet over any one stringer.

For floor widths such that full length pieces can not be obtained, effective span lengths for M (M= Simple span moment) may be used under the following restrictions:

(1) Each piece shall be of sufficient length to bear on at least three stringers.

(2) Generally splices shall be made on the center line of a stringer.

(3) Splices shall not occur oftener than once in every second piece on any one stringer.

Figs. 1, 2, and 3 are taken from the memorandum excerpted above. Letters in the figures have the following significance:

P = Load on rear wheel = 40% of weight of truck.
S = Effective span length.
S' = Stringer spacing = S + ½ b (b = width of stringer flange).
A = 6'-0" for one truck loading.
A = 3'-0" for two truck loading. See Fig. 1, 2 and 3.

Since working stresses published for timber include an allowance for impact, no such allowance should be made in the design.

To illustrate the design, assume the case diagrammed in Fig. 2, where the stringer spacing is insufficient to permit two wheels spaced 3 ft. apart to be so placed in the interval between two stringers that they produce a greater bending moment than the single wheel placed in the center. Let the live load be a 15-ton truck with 40 per cent of the load on one rear wheel, and let a 2 x 4-in. (rough) strip floor of a structural grade of plank be specified, permitting a working stress f = 1,600 lbs. in bending. Then,

Live Load P = 30,000 lbs. x 40% = 12,000 lbs.
W = dead load per lineal inch of span = 5 lbs. (timber at 60 lbs. per cubic foot and wearing surface at 25 lbs. per square foot).

Section Modulus $\dfrac{bd^2}{6}$ for 15-in. width 4 in. in depth $= \dfrac{15 \times 4^2}{6} = 40$

S = Distance in inches between stringer faces plus one-half the width of one stringer. See Fig. 2.

Since 8/10 of the simple span moment is used,

8/10 (live load moment plus the dead load moment)

$$= \frac{fbd^2}{6} = 64{,}000 \text{ lbs., or}$$

$$8/10\left(\frac{PS}{4} + \frac{WS^2}{8}\right) = 64{,}000 \ldots (1)$$

Substituting the above values of P and W, S = 27 in.

If stringer widths of 6 in. are used, then S', the permissable stringer spacing = 27 in. + one-half the width of one stringer = 30 in.

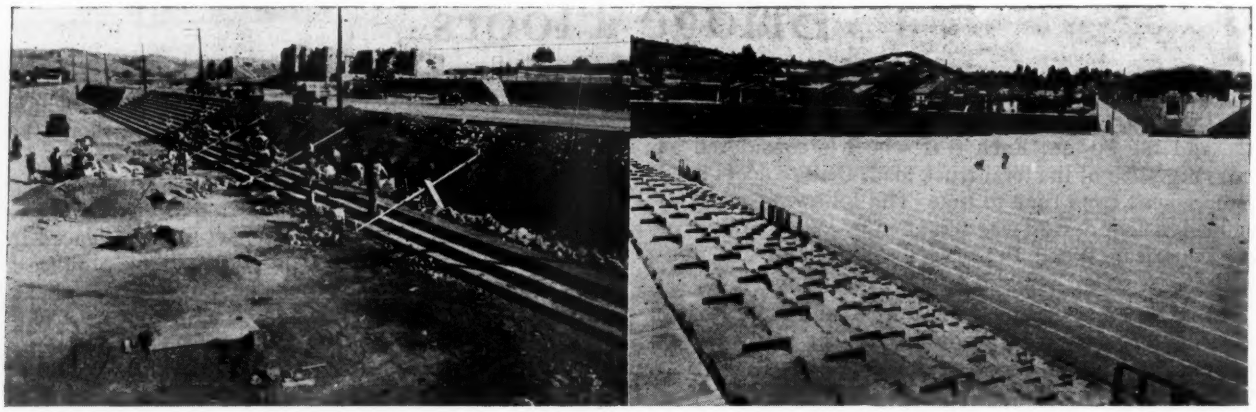
While formula (1) includes the dead load, with the ordinary stringer spacing used with lighter floors the dead load moment is so small it has little effect on the result and in practical computations the term $\dfrac{WS^2}{8}$ may be neglected.

Fig. 3 illustrates cases arising where heavier floors are used and the spacing between stringers is sufficient to permit both rear wheels of the truck, or the two wheels of passing trucks, which by specification are fixed at 3 ft. apart, to fall between two stringers. The diagram shows the mid-point of the span bisecting the distance between the nearer load and the center of gravity of the two loads—the position of loads necessary to produce the maximum movement in the span. Again, the effective span used in computing the moment is the distance between stringer faces plus one-half the stringer width.

After the bending moment is computed for the loads in positions shown on the diagram, the effective span length is determined by the method illustrated in the preceding example.

The foregoing computations disregard the lateral distribution of the wheel on the floor. Some engineers consider the live load uniformly distributed over a part of the span and take the bending moment as 8/10 of the simple beam moment computed for a span length equal to the spacing center to center of stringers, with the load uniformly distributed at the center over a distance equivalent to the specified tire width. Specifications, however, commonly prescribe rear tire width of one inch per ton of total truck weight. The rear tire width of a 15-ton truck would, therefore, be 15 in.. When this live load is considered distributed uniformly over a 15-in. width at the center of the span, the resulting bending moment is somewhat less, and slightly larger stringer spacings are permissible.

In computing the strength of floor plank or strips horizontal shear should be ignored. If the horizontal shear were figured by conventional formulae, timber would in many cases apparently be overstressed. It must be remembered, however, that working stresses published for shear are based on predicted checking of large pieces. In the case of plank, these checks would occur at right angles to the shear plane and would have no effect on the strength of the piece in shear. In the case of strips which are closely spaced, checking would be prevented. Lumber of the size used in bridge floors would crush at the bearing before it would be taxed in shear.



Constructing bleachers at left. Right, stadium built by popular subscription

Arizona City Utilizes Permanent Projects for Relief

PRESCOTT, ARIZONA, furnishes an exceptional example of a continuing program of permanent public improvements for relief.

During 1935 the Park Commission of Prescott expects to complete the improvement of one park and recreation center which was started in 1930, and on which work has been continued since. Other projects of this character will be inaugurated as rapidly as practicable.

All work was done by local labor through cooperation of the citizens of Prescott, the county of Yavapai, and the Yavapai County Chamber of Commerce, acting through its welfare board in their general work program and in their R. F. C., C. W. A., and E. R. A. departments.

The project under way is an athletic field 340 by 600 feet, with seating capacity for 4,000 and parking space for 500 cars. In an adjacent area four double tennis courts with bleachers for 1,000 are completed. The entire recreation center is surrounded by rock walls, presenting a pleasant view and healthful recreation for all.

In 1930. 10,000 cubic yards of earth and rock were excavated from the field and 1,200 yards of surfacing were applied. This was financed by city funds.

In 1931, money was raised for relief work and the first retaining wall was constructed. The Smoki Indians, who annually give a tribal dance, built a pueblo of native stone. A concrete stadium sponsored by the Kiwanis Club was financed by the sale of 600 tickets at $12.50 each. And a bleacher seating 1,100 people was built with R. F. C. labor, materials for which were obtained by funds held in trust by the Rotary Club, which were turned over to the Park Committee.

In 1932, the school board furnished cement and steel for two tennis courts which proved so popular that two more were added, the area fenced and seats provided for spectators.

In 1933, under the C W. A. program, the remainder of the stone seats and walls were finished. Water and sewer lines were run and a public restroom was built.

A feature of the work was the extensive use of local field stone laid up in portland cement mortar. Local aggregates were also used in the concrete and mortar, so that the widest possible use of local labor was made, both directly and indirectly.

Plans are now under way to fence completely and screen with vines the entire field, to floodlight the tennis courts and to complete the locker rooms under the stadium.

Public approval of this improvement has been so general that the Park Commission of Prescott plans a continuing program to beautify and improve the city.

Arthur J. Kline, city engineer, has actively assisted in the program.

Studies in Water Consumption

BELOW are given figures of water consumption by months in fifty cities of the three North Atlantic States, the figures being percentages of the total annual consumption of the city in question, without reference to per capita consumption. The small table shows the average percentages for five sections of the country. The most prominent feature shown by the comparison is the big summer rise in the Pacific States (due, presumably, to the use of a considerable part of the supply for irrigation), as compared with the industrial North Atlantic States, and especially with the quite uniform rate of the agricultural South Atlantic.

Average Monthly Consumption (Percentage of Total for the Year) in Five Sections of the Country

	Jan.	*Feb.*	*March*	*April*	*May*	*June*	*July*	*August*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
New England	7.81	7.10	7.89	7.76	8.69	9.08	9.51	9.28	8.53	8.31	7.93	8.11
North Atlantic	7.90	7.59	8.11	7.60	8.37	8.95	9.26	8.89	8.50	8.48	8.03	8.32
South Atlantic	7.74	7.30	7.91	7.68	8.95	9.10	8.86	8.93	8.66	8.62	8.16	8.11
South Central	7.30	7.06	7.30	7.69	8.66	9.95	10.35	9.51	8.99	8.36	7.42	7.41
Pacific Coast	75.1	5.28	6.56	7.99	8.21	10.23	11.67	11.91	9.87	8.81	7.43	6.28

Monthly Water Consumption, in Percentage of Total Annual Consumption, for Cities of the North Atlantic States

City and State		*Per Cent Metered*	*Consumption*	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
NEW JERSEY:															
Belleville	28,000			6.83	7.82	8.10	7.95	8.37	8.10	8.23	8.52	9.35	8.10	8.23	10.33
Bridgeton	16,000			6.40	6.33	6.90	6.98	8.06	10.47	10.26	10.11	9.64	9.11	8.12	7.78
Glassboro	4,500			7.59	7.09	7.61	7.40	8.62	9.20	8.93	9.07	9.00	9.24	7.92	7.76
Hammonton	7,656			7.14	6.52	7.70	7.00	7.84	9.63	9.80	10.08	9.10	8.75	7.77	7.87
Hoboken	62,000			9.70	8.85	9.12	7.36	8.62	8.38	8.43	8.35	8.12	8.34	7.38	7.24
Rahway	17,000			8.87	8.10	8.14	7.32	8.02	8.92	9.52	8.60	9.10	8.10	7.48	8.31
Ridgewood	21,000			8.18	7.31	8.05	7.95	8.80	9.77	10.10	8.46	7.96	8.03	7.69	7.66
Bloomfield	38,077	100	75	9.54	7.00	7.82	7.64	7.74	7.98	8.72	8.86	8.55	8.58	8.67	8.82
Elizabeth	114,585	100	56	7.82	7.14	7.75	7.62	8.62	9.20	9.11	8.91	8.51	8.82	8.16	8.25
Hawthorne	13,000	100	73	7.14	6.87	7.65	7.38	8.38	8.37	8.87	8.14	10.38	11.21	7.71	8.10
South Amboy	8,500			8.80	8.60	7.66	7.96	7.96	7.88	9.31	8.92	7.58	8.90	7.61	8.82
Jersey City		100	126	8.20	7.09	7.97	7.85	7.57	8.42	8.79	8.67	8.11	9.16	8.73	9.60
NEW YORK:															
Haverstraw	10,200	100	86	7.59	8.71	9.34	9.10	8.56	7.49	8.18	8.37	8.06	8.65	7.57	8.58
Auburn	38,000	100	128	6.93	7.08	7.17	7.95	8.13	9.62	9.81	9.12	8.35	8.59	8.46	8.76
Cohoes	23,560			8.11	8.27	8.17	8.05	8.50	8.45	8.45	8.45	8.38	8.30	8.35	8.30
Scotia		100	69	7.60	6.95	7.90	7.81	8.83	10.70	10.07	8.51	8.06	8.01	7.38	8.11
East Aurora	4,920			6.83	7.60	9.20	8.00	10.18	8.63	10.50	8.80	8.46	7.82	7.03	6.92
Kingston	28,000			8.07	7.48	7.94	7.26	8.12	9.71	9.65	8.77	8.10	8.02	7.75	9.18
Mohawk	3,000			8.29	8.31	7.48	8.40	7.53	9.27	8.73	8.43	8.59	7.17	8.65	9.09
New York	7,306,000			8.02	8.15	8.12	8.11	8.23	8.75	8.71	8.67	8.53	8.37	8.14	8.19
Salamanca	9,985			7.60	7.55	8.32	7.90	7.90	7.97	8.52	8.89	8.32	8.84	8.38	9.92
Portland	16,000	100	100	8.20	7.40	7.82	7.70	8.51	8.84	9.06	9.00	8.62	8.46	8.05	8.45
Dansville	4,500			7.58	7.34	8.55	7.50	8.32	8.05	8.55	9.36	8.87	8.47	9.06	8.46
Elmira	65,000			8.55	7.81	9.10	8.70	8.57	8.43	8.65	8.74	8.34	7.84	7.52	7.77
Herkimer	10,685	100	75	7.40	7.15	8.00	7.59	8.00	8.59	9.40	9.66	9.50	9.10	8.00	7.41
Ithaca	20,700	100	45	8.09	7.22	8.88	8.10	8.79	8.64	8.78	7.71	7.83	9.03	8.72	8.21
Waterford	5,200	100	52	8.93	10.77	10.40	8.20	7.30	7.03	7.83	7.72	8.23	8.00	7.68	8.10
Seneca Falls	6,443	95	86	8.16	7.43	7.98	7.64	8.11	9.06	10.30	9.21	8.44	8.07	7.76	7.82
Scarsdale	12,500			7.24	6.68	6.73	6.89	8.86	8.73	12.20	11.02	9.47	7.60	7.06	7.32
Ossining	15,240	100	55	7.93	7.30	7.60	6.88	9.08	9.83	10.35	9.56	8.25	7.91	7.60	7.75
Oneonta	14,459	35	102	7.69	7.14	8.12	8.20	9.20	9.88	9.37	8.21	8.12	8.15	7.54	8.32
Mt. Vernon	61,499	100	76	8.71	7.67	8.40	8.17	8.45	8.53	8.42	8.27	8.15	8.47	8.17	8.60
Mamaroneck	25,000	100	107	9.02	8.67	8.90	8.22	8.34	8.40	8.34	8.56	7.90	7.76	7.82	8.03
Malone	8,860			8.42	7.67	8.45	8.24	8.85	10.09	9.56	8.02	7.96	7.75	7.55	7.38
Lyons	4,000			7.72	6.94	8.02	6.70	7.63	10.27	10.96	8.85	8.70	8.68	7.37	8.67
PENNSYLVANIA:															
Ambler		100	100	7.64	7.16	7.82	7.78	8.11	9.43	9.88	9.70	9.03	7.98	7.84	7.52
Allentown	95,500			8.00	7.22	7.87	8.00	8.62	8.98	9.21	9.13	8.46	8.43	8.00	8.22
Altoona	82,000			8.71	7.81	8.00	7.48	7.87	8.25	8.97	9.42	8.45	8.32	8.13	8.52
Frackville	8,500			7.93	7.34	7.83	7.36	7.76	7.98	8.40	9.38	8.18	9.25	9.51	9.33
Media	11,000			8.20	7.50	8.06	7.26	7.78	9.57	8.92	8.77	8.34	9.56	8.10	7.92
Oil City	26,000			8.03	7.01	8.55	10.22	9.06	8.91	8.21	7.12	8.88	8.90	8.06	7.24
Stulton	13,000			7.33	6.45	7.20	6.72	7.83	8.55	9.61	9.26	9.35	9.67	8.85	9.16
Wilkinsburg	150,000			7.60	6.96	7.52	7.50	7.72	8.95	9.60	9.56	8.78	8.80	7.86	9.11
Beaver	6,000			8.86	7.46	7.56	7.56	9.80	10.55	9.82	7.92	7.66	7.76	7.62	7.53
Bloomsburg	10,000	5	68	8.48	7.26	8.14	7.31	7.97	8.57	8.74	8.93	8.45	8.61	8.30	8.74
Catasaqua	4,851			8.58	7.85	8.63	8.50	9.17	9.47	9.01	8.70	7.66	7.32	7.20	7.82
Danville	7,590			8.90	9.18	8.43	7.88	7.90	8.13	8.21	8.43	8.12	8.08	8.22	8.43
Huntingdon				8.33	5.90	8.33	7.70	8.68	10.25	9.23	9.11	8.05	8.00	8.04	8.28
Jersey Shore	6,500	7½	134	9.72	9.72	7.40	8.36	7.85	7.84	7.82	8.16	7.66	7.47	8.95	9.06
Sewickley	6,000	100	80	7.92	7.14	7.19	6.64	7.90	10.81	10.91	10.66	7.14	8.27	7.70	7.55
Average				7.90	7.59	8.11	7.60	8.37	8.95	9.26	8.89	8.50	8.48	8.03	8.32
Maximum				9.72	10.77	10.40	10.22	10.18	10.81	12.20	11.02	10.38	11.21	9.51	10.33
Minimum				6.40	5.90	6.73	6.64	7.30	7.03	7.82	7.12	7.14	7.17	7.03	6.92

Evaluation of Residual Chlorine

ORTHOTOLIDINE has been used almost exclusively for the estimation of residual chlorine in water since its standardization in 1913. It is extremely sensitive, and requires but one manipulation, the addition of an indicator, which produces a color varying in intensity with the quantity of chlorine present.

Unfortunately, a few other substances produce practically the same color as chlorine, the chief of these being manganese, nitrites and iron. The yellow color is produced by oxidation in an acid solution and manganese and ferric compounds, as well as chlorine, are strong oxidizing agents. Nitrites produce a yellow color by diazotization. Lignin in ground wood pulp also produces a yellow color.

To date, no material has been found which is sensitive to residual chlorine and at the same time unaffected by outside influences, although Tarvin, Todd and Buswell investigated more than 50 compounds with a view to finding one.

Iron in combination with organic matter appears to increase the activity of ferric ions toward orthotolidine. Scott obtained varying apparent residual chlorine readings in waters containing different amounts of organic matter but no chlorine. Experiments have demonstrated that iron in water in amounts less than 1.0 ppm. may have little effect on the orthotolidine test, especially if the readings are made within 20 minutes. Since the iron content of the average domestic water seldom exceeds 0.3 ppm. orthotolidine tests are not likely to be affected by it; but the chemist should make sure that the iron content does not exceed this amount or, if it does, take corrective measures. In the past such correction has been effected by precipitating the iron with an excess of sodium hydroxide.

Manganese may be removed from the solution by flocculation with magnesium sulphate and sodium hydroxide. After centrifuging at 1,000 rpm. for 3 minutes the supernatant is decanted off and tested with modified orthotolidine; the reading being made after 5 minutes. This is a somewhat complicated procedure but gets rid of the iron and manganese.

The New York State Dept. of Health recommends the following method for eliminating manganese in the absence of chloramines: Collect two samples. Determine residual on one at once. After 24 hours (when the chlorine is assumed to have been dissipated) determine residual on the other. Subtract the results, and the difference will represent the true residual. Enslow boils off the chlorine in place of exposing the sample for 24 hours.

Nitrites and chlorine can not exist together; but nitrites and chloramines may, since the latter are not strong oxidizing agents. Where chloramines are used it is usually advisable to test for nitrites directly with sulphanilic acid and alpha-naphthylamine acetate. According to Scott, 0.05 pp. of nitrite nitrogen gives an apparent chlorine value of 0.005; 0.1 nitrogen gives 0.01 apparent chlorine; 0.2 nitrogen gives 0.015 apparent chlorine, etc. Few natural waters contain more than 0.1 ppm. nitrites, and as residuals are seldom read closer than 0.01 ppm., the difficulty is not a serious one.

Organic matter is sometimes stated to react with orthotolidine like chlorine, but this is probably really due to the iron or manganese in the matter.

Scott suggests that a modified orthotolidine reagent (standard O. T. solution 50 cc., distilled water 35 cc. and concentrated hydrochloric acid solution 15 cc.) will materially reduce errors due to nitrites and ferric iron. Griffin has found that where too much acid has been used the color fades very rapidly, producing low results unless readings are made immediately after the addition of the indicator. Orthotolidine of around 20% acid concentration has been employed very successfully in certain sewage work.

In general, corrective measures should always be taken wherever manganese is present. Since all methods appear to have a certain degree of error it would probably be well to apply not only the boiling-off method but also the magnesium sulphate and two-sample methods. The one giving the closest to an average of these could then be adopted for routine use, with an occasional check with the other two.

The above is condensed from a paper by A. E. Griffin, research chemist with Wallace & Tiernan Co., before the Four-States Section of the American Water Works Association.

Municipal Water Softening Plants in Ohio

Municipal water softening plants in Ohio now number 58. Seven new plants were completed recently and put in operation. Five of them were financed under the Public Works Administration. Following is a summary of the recent developments:

New Philadelphia (city) has put in service a new *zeolite* plant which softens a deep well water. It cost $71,055 and has a capacity of 2 m. g. d.

Reading (city) lately installed a *lime-soda* plant, which also softens water from a deep well. It has a capacity of 1 m. g. d. and cost $34,712.

Mt. Sterling (village) had a hard water which also contained considerable iron. Its softening plant combines *aeration* and *lime* treatment. It cost $12,006. Plant capacity is 160 g. p. m., with double filter capacity.

Grafton (village) water supply is derived from an old stone quarry. It was hard and contained some iron. Filters were installed for iron removal and softening by the *lime-soda* process. Plant capacity is 50 g. p. m., with filter capacity doubled. The cost was $10,000.

Worthington (village) supplemented its deep water supply by drilling a new well. A filtration plant for iron removal and a *zeolite* softening unit have been put in operation with 150 g. p. m. capacity. Cost was $19,057.

Canal Winchester (village) has completed a *lime-soda* plant for softening deep well water, with capacity of 240 g. p. m. It was financed locally and no data are available as to cost.

Elmore (village) has put a *zeolite* plant in service to soften a very hard deep well supply. The softening units are entirely automatic, with regeneration and washing of units operated by devices actuated by contacts on a meter. To correct the corrosive qualities of this water *sodium hydroxide* and *sodium silicate* are added after softening. Plant capacity is 150 g. p. m. Cost data are not available.—*Ohio Health News.*

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Chemical-Mechanical Treatment of Sewage

By Philip B. Streander* and Michael J. Blew†

II—Coagulating Chemicals and Their Application

Governing Factors Choice of the coagulating chemicals to be used is determined largely by local conditions such as freight rates, the capacity or size of the plant, and the characteristics of the sewage, including the influence of the water supply upon them, and the effect of various trade-wastes (if any) included in the sewage to be treated. Commercially available chemicals are ferric chloride, ferric sulphate and ferrous sulphate. In the conditioning of sludge below a pH of 7.0 ferric chloride is preferable to other iron salts. Above a pH of 7.0 this preference does not apply to the same extent. Where sludge is dewatered prior to further treatment, the method of dewatering (that is, over or under the neutral point) further affects the choice of coagulating chemicals.

Ferric Chloride Ferric chloride is now available in three forms, namely:

1. *Liquid*—an aqueous solution which is prepared to contain between 39 and 45 per cent $Fe\,Cl_3$ by weight.
2. *Crystals*—A definite crystal of the formula $Fe\,Cl_3.\ 6\ H_2O$ containing 60 per cent $Fe\,Cl_3$ by weight.
3. *Anhydrous*—A complete water-free form containing 98 per cent or more $Fe\,Cl_3$ by weight.

Liquid ferric chloride is easily handled and for large plants located reasonably close to the source of supply is the most economical form of ferric chloride. Its use requires ferric chloride-resistant storage tanks of a volume not less than a carload lot of 8,000 gallons plus sufficient to supply the plant between shipments.

Commercial ferric chloride crystals are in the form of large yellow or brown lumps, and are shipped in wooden barrels having a tare weight of about 435 pounds. Barrels should be stored in a dry location in a room having a temperature not exceeding 98°F.

Anhydrous ferric chloride consists of greenish-black crystals, readily soluble in water and has a high melting point. It is shipped in steel drums containing 150 pounds of material.

Ferric chloride, on account of its hygroscopic nature, is applied to the sewage in the form of a solution. Dissolving tanks, piping and feeders must be constructed of ferric chloride-resisting materials such as rubber, glass, ceramic materials or special metals. Dissolving tanks are required for the crystal and anhydrous ferric chloride; and all forms of ferric chloride require dilution or solution tanks in which the concentrated solution can be diluted to between 3 and 4 per cent concentration. Solution feeders can be of the positive displacement or variable syphon head type, either manually or automatically regulated.

Ferric Sulphate Ferric sulphate is now commercially available under various trade names and contains between 20 and 25 per cent ferric iron. It is a granular substance ranging in size between 4 and 11 mesh. One form of this trademarked "Ferrisul" is shipped in paper-lined burlap bags containing 180 pounds net, or in slack barrels containing 380 pounds net. This material in the anhydrous form of $Fe_2\,(SO_4)_3$ is furnished at the present time to the following specifications:

Anhydrous ferric sulphate—not less than 90%
Ferrous sulphate—not more than 1.5%
Insoluble matter—not more than 2.0%

No storage difficulties are involved in its use as it does not bulk, nor does it have any tendency to melt in hot weather. It is readily soluble when the proportion of water is limited to two parts by weight to one of ferric sulphate and sufficient agitation is provided to keep the particles in suspension Anhydrous ferric sulphate has an appreciable heat of solution and it is not uncommon to secure temperature rises of 30° C. to 40° C. in the dissolving pot.

Ferric sulphate can be proportioned and applied to the sewage by means of dry-feed machines in which corrosive-resisting metals are used for parts in contact with the material, and provided with a dissolving pot of proper proportions. Ferric sulphate can also be applied to the sewage by means of solution-feed boxes of the constant-head, variable-orifice or variable-syphon head type, either manually or automatically regulated. For solution feeding there is required a dissolving tank in which the ferric sulphate is dissolved in a definite quantity of water, and a solution tank in which the concentrated solution is mixed with a sufficient quantity of water to provide a controllable concentration. Solutions, both dissolved and concentrated, are quite corrosive to ordinary metals and all equipment and piping in contact with them should be lead or rubber lined.

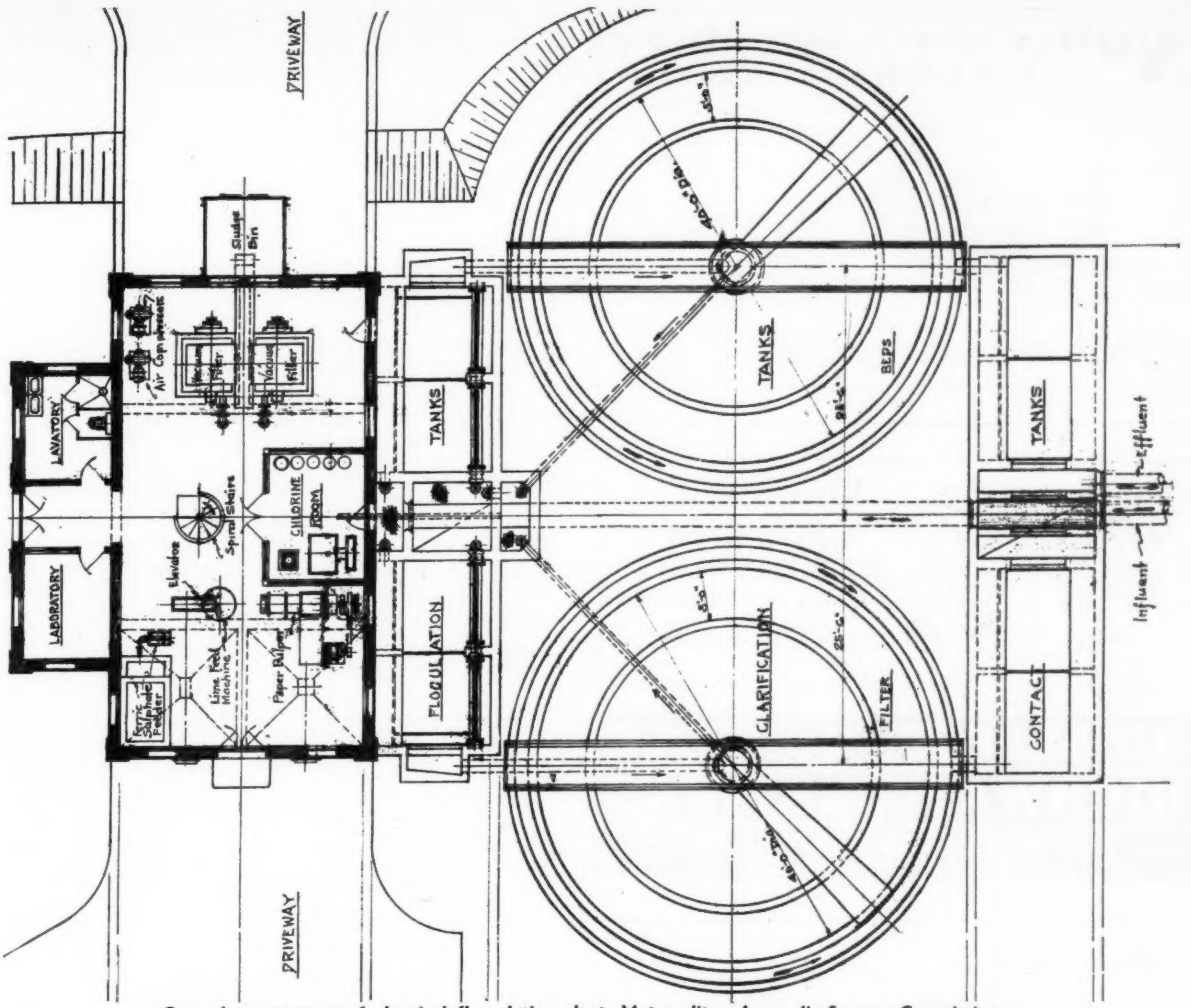
Ferrous Sulphate Ferrous sulphate, or copperas, is a by-product in paint manufacturing and many other industries, which is conditioned and crushed for commercial use. It is furnished in 200-pound bags or in 400-pound barrels, or can be purchased loose in carload lots. It comes as greenish crystals which dissolve readily in cold water. The storing of bagged or barreled copperas does not present any particular problems. When stored in bulk or loose form, the bins should be made reasonably air-tight.

Copperas can be proportioned and applied to the sewage by means of dry-feed machines provided with dissolving boxes having detention periods of between 20 and 30 minutes. It can also be proportioned and applied in solution form, in which case it is mixed with a definite quantity of water to secure a predetermined concentration, generally ranging between 2 and 4 per cent. This method of feeding requires solution storage tanks, the volume of which depends on the number of times the batches are made up. All equipment and piping used for the solution should be rubber or lead-lined.

Chlorinated Copperas Chlorinated copperas consists of a mixture of a copperas (ferrous sulphate) solution with a chlorine solution, according to the following reaction:

$$3\ FeSO_4.\ 7\ H_2O + 1.5\ Cl_2 = Fe_2\,(SO_4)_3 + Fe\,Cl_3 + 21\ H_2O.$$

*Of Watson and Streander, New York, N. Y.
†Research Engineer, Philadelphia, Pa.



General arrangement of chemical flocculation plant, Metropolitan Annapolis Sewage Commission

The reaction is practically instantaneous and the ferric salts are immediately available. The theoretical ratio of chlorine to ferrous sulphate is 1 to 7.8. One pound of ferrous sulphate will oxidize to 0.48 pound of ferric sulphate ($Fe_2(SO_4)_3$) and 0.19 pound of ferric chloride ($FeCl_3$), requiring 0.11 pound of chlorine for the conversion. A slight excess of chlorine is necessary to secure the desired result and in actual practice about 15 per cent by weight of the chlorine is required.

The application of chlorinated copperas to sewage requires the use of two separate feeders, one for the ferrous sulphate and the other for the chlorine. The proportioning and feeding of the ferrous sulphate can be done by means of dry-feed machines of a type previously described, and the proportioning and feeding of the chlorine can be done by means of the conventional type of chlorine solution machine. The ferrous sulphate can also be proportioned and fed in solution form using food boxes, dissolving and solution tanks as described for the use of ferric sulphate. The amounts of the respective chemicals fed can be either manually or automatically controlled. The materials used for the ferrous sulphate solution and the combined ferrous sulphate and chlorine solutions should be either lead or rubber lined or other acid resisting materials. Chlorine can be purchased in one-ton containers or, for large plants, in tank car lots. The same storing and handling precautions are required for this as for the usual chlorine equipment installation

Available Iron The ferric iron content of any commercial form of ferric salt is of considerable importance, as this determines largely the comparative cost of the various forms. A comparison of the amount of ferric iron available in the various salts shows the following:

Ferric chloride—anhydrous	34%
Ferric chloride—crystals 60%	20%
Ferric chloride—liquor 45%	15%
Ferric sulphate—"ferrisul"	25%
Ferric sulphate—"calcoag"	20%
Ferrous sulphate—fully oxidized	20%

In the chemical treatment of sewage all iron salts are about equally effective on the basis of the available ferric iron. The choice therefore should be based on the relative cost of the various salts on the basis of ferric iron content and not on the price per ton of the chemical.

Lime Lime is strongly basic, which property has led to its wide use as a cheap alkali. It can be used in either the hydrated or quick-lime forms, but should be of high calcium content. Quick-lime should have not less than 88 per cent calcium oxide, and hydrated lime 90 per cent calcium hydroxide which is equivalent to 68 per cent calcium oxide. The choice depends to a certain extent on the relative cost of the two materials on the calcium oxide basis, as well as on the size of the treatment plant. Hydrated lime is more suitable for the smaller plants as it can easily be stored, does not re-

quire slaking equipment and can be fed to the sewage by means of a dry-feed machine. Quick-lime costs less per ton of available calcium oxide and is therefore more economical for use in large plants, and by thorough slaking or hydration to calcium hydroxide it reacts much more quickly. Lime is sparingly soluble in water, forming when fully saturated a solution called lime water. Lime water which is white with suspended but undissolved particles of the hydroxide, is known as milk of lime. Saturated lime water reacts much more quickly than milk of lime, but is more difficult to prepare and apply to the sewage than milk of lime. This disadvantage can be overcome by providing the proper equipment in the plant for the slaking and preparation of the milk of lime solution and its application to the sewage. The slaking of quick-lime is most efficient at temperatures between 140°F and 180°F and about 3 pounds of water is required for each pound of quick-lime. Too much water drowns the lime, retards the hydration and results in the formation of a lumpy and improperly slaked mixture. An insufficient quantity of water causes the lumps of quick-lime to swell and form a white, lumpy and partly hydrated mixture.

Quick-lime can be purchased in air-tight steel drums or loose in carload quantities. If purchased by the carload it can be unloaded from the car to the receiving station pneumatically or by means of power shovels and elevators It can be stored in steel tanks, which should be reasonably air-tight to prevent air-slaking. If a milk-of-lime solution is to be used the quick-lime can be slaked in a concrete mixer, a pebble-mill or in steel tanks fitted with power-operated revolving rakes. The slaked lime is then mixed with the quantity of water required to form a definite percentage of calcium-oxide, generally 4 per cent. The solution storage tank can be made of either steel or concrete construction and should be of sufficient size to hold a supply equal to not less than 6 hours usage. Thorough agitation must be provided to prevent stratification, otherwise the feed of lime will not be uniform. Agitation is generally secured by means of power-driven paddles, or a high-speed propeller near the bottom of the tank serving to keep the entire volume in circulation. The milk of lime is added to the sewage by means of a solution-feed box to which the solution is piped in a volume in excess of the rate of application, the excess being pumped back to the solution storage tank. The rate of feed can be adjusted either manually or automatically to maintain proper pH control.

With dry proportioning, the feeder is located under the lime storage tank and feeds the lime into a dry-feed machine. This is followed by a slaking tank in which a definite volume of water is mixed with the lime. The discharge from the slaking tank is then mixed with diluting water to form a milk of lime, which is conveyed to the sewage. While comparatively simple in operation, this method of slaking and feeding has certain disadvantages. Unless a period of between 15 and 30 minutes' detention is provided in the slaking and dilution tanks, the resulting milk of lime is not fully hydrated and causes a delayed reaction in the focculation tank.

Hydrated lime is purchased in barrels or paper bags and should be stored in a comparatively dry room. It is usually applied to the sewage by means of a dry-feed machine having an integral storage hopper. The machine should be provided with a well baffled dissolving tray to assure complete slaking of the lime before it is applied to the sewage. Dry-feed machines for feeding and applying either slaked quick-lime or hydrated lime can be either manually or automatically

controlled. All lime should be purchased under rigid specifications

Experimental Work The determination of the coagulating chemical to be used in any plant is one which should be given careful consideration. Actual experiments should be made if possible, using those chemicals which investigation indicates as being best applicable. The more thoroughly such experimental work is conducted the more certain will be the results and conclusions obtainable. If experimental procedure cannot be followed, the choice of the chemical to be used should be based on a wide experience supplemented by a study of the character of the water supply and the influence of any trade wastes.

The third installment will appear next month.

How to Make Watertight Concrete

There is no secret about how to make watertight concrete. The elements of how to do it are given below:

(1) Provide an adequate design to sustain the loads to which the structure will be subjected, with adequate foundations and reinforcement to prevent settlement and cracking.

(2) Use well-graded aggregates. The sand should contain at least 10 per cent, but not more than 30 per cent, of fines passing the 50-mesh sieve.

(3) Control the mixing water. This means actual and accurate measurement of the water for each batch. For most cases the mixing water should not exceed 6 gallons per sack of portland cement. For very thin reinforced sections, this should be reduced to 5½ gallons. For very heavy sections, such as gravity dams, the amount may be increased to 7 gallons. These amounts include the free moisture in the aggregates.

(4) Proportion the materials to provide a workable mixture, requiring some puddling to get smooth surfaces, which will not permit the materials to segregate nor water to collect on the surface. With well-graded materials, about 40 per cent fine and 60 per cent coarse give a good mixture.

(5) Mix the concrete thoroughly. Increased mixing is of great assistance in getting better workability and uniformity.

(6) Place concrete in forms in uniformly thin layers, spading along forms to get smooth surfaces. Do not permit concrete to flow over long distances in the forms as this will cause water and fine particles to collect at the ends of the section being placed. Place continuously to avoid construction joints. Use vibration.

(7) If it is necessary to make a construction joint, provide one that will be watertight. With a good mix there will be no laitance. If there is laitance it should be removed and the concrete then moistened A good method to follow is to brush or scrape the concrete before it is thoroughly hard, thus removing the fine materials from the top of the layer. A ½-inch or so of grout—1 part portland cement to 2 parts sand—should be placed on the moistened concrete just before proceeding with the fresh concrete. For high pressures in thin sections, a metal dam in the joint is advisable. This may be galvanized iron or copper, from 16- to 20-gauge, 6 to 8 inches wide, half of it being placed in the lower lift and the other half in the upper.

(8) Cure the concrete. This means keeping it wet but not subjecting it to hydraulic pressure. Forms left ing place on vertical surfaces help to prevent evaporation Horizontal surfaces should be covered with wet sand or other suitable cover and kept moist. Curing should continue for at least a week.

County Roads Ruined by Dust Storms

Writing us several weeks ago, G. P. Wyland, engineer of Gray County, Kansas, and supervisor of the Work Relief Program, commented on the dust and sand storms prevalent this spring in that state, as follows:

This particular county operates under the county unit system whereby the county has control of all roads within the county except state roads. This gives the county about 1,200 miles of road to grade and maintain. We have at this date (May) some 300 miles of road that is practically impassable, owing to the drifts of sand filling the roads. In other places the road bed has been scoured out by the high winds until it is impossible to drive over some of them.

This county has many rural high school districts, the children being collected by buses and hauled to school. Many miles of the bus routes are impassable. The Cimarron High School has been closed for three weeks owing largely to the impossibility of getting the buses over the routes.

Practically 1,000 miles of roads in this county, formerly in good shape so far as blade and grader work is concerned, have the ditches filled level full with blow dirt, and the culverts filled with dust. There is no place for the water to drain. Just what these western counties are going to do when it starts raining, no one knows.

Practically all of the road work done during the past year in this county has been in support of the Drouth Relief Work, whereby the relief fund pays the hand labor and teams, and some trucks. The country is almost devoid of teams, the horses having died or been sold on account of the scarcity of feed, and these are being replaced with tractors. We have about 375 men on road work and only about 40 horses at the present time. The county is operating continuously two large elevating graders ahead of the relief labor. If it were not for these, the relief labor would do very little good. The county has enough money coming in for maintenance, with little left for new construction.

These remarks are just to give you a little idea of conditions that exist a long way from New York.

(Ed. Note: Thank you, Mr. Wyland. We are sorry to hear of the troubles you and your people have been having, but we are not totally unfamiliar with them. Thirty years ago my father had quite large holdings in the county just northeast of you, and there were some hard times in those days, too.)

Road Maintenance Costs With Diesel Power

During the past few months we have received several requests from our readers for data on the savings obtained by the use of diesel power on maintenance and construction machinery. The following authentic information is reported to us by the Caterpillar Tractor Co. as being illustrations of average costs in road maintenance with diesel power. The four townships are all in Illinois. Results should be equally good in any state, county, city or township.

Reported by Commissioner L. C. Doetschman, Kendall township; tractor consumes 12 gallons of 6½ cent fuel per 10-hour day, for 78 cents, or 7.8 cents per hour;

Reported by Commissioner Ed Rust, Will township; tractor operates on 13 gallons of 7-cent fuel, 10½ hour day, for 91 cents, or 8.6 cents per hour;

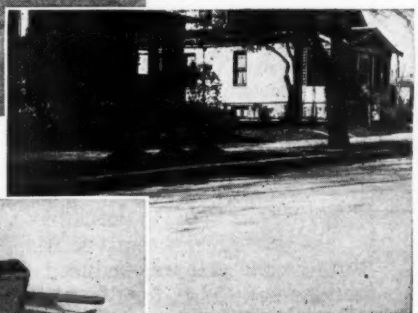
Reported by Commissioner William Glasgow, Plainfield township; tractor burns 11 gallons of 7-cent fuel, 9-hour day, for 77 cents, or 8.5 cents per hour;

Reported by Commissioner John Konicek, DuPage township; tractor operates on 10 gallons of 7-cent fuel, 8-hour day, for 70 cents, or 8.7 cents per hour.

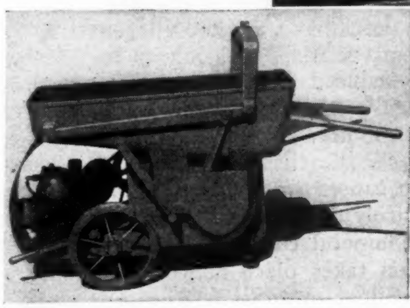
Average hourly fuel cost for these tractors is only 8.4 cents.

MUD-JACK METHOD

Curb and gutter depression before application of Mud-Jack Method



Above curb and gutter after elevation by the Mud-Jack Method— Reconstruction cost has been saved



No. 10 N. E. C. Mud-Jack

Saves the Curb, Gutter and Sidewalk

The Mud-Jack method of raising concrete curb, gutter, walks, and streets has solved the problem of reclaiming and correcting sunken concrete slab. It is the modern method to increase the life of concrete. Curb, gutter, walks and streets can be raised to original grade. All of this without reconstruction — the saving accomplished pays for the machine in less than one season's operation—in addition to the protection of the original investment.

Write for Mud-Jack Bulletin

KOEHRING COMPANY

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For Raising Concrete Curb, Gutter, Walks, Street

CONCRETE VIBRATORS

Air operated vibrators for all classes of concrete construction including Bridge deck slabs, Dams and Locks, Highway pavement and Concrete products.

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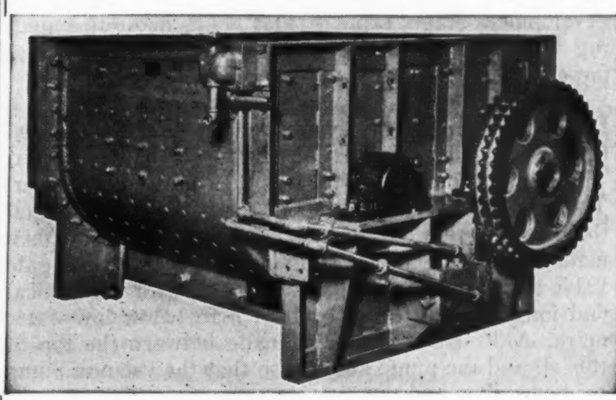


COMPACT DESIGN
WELDED STEEL CONSTRUCTION
ANTI FRICTION BEARINGS
ADJUSTABLE & REMOVABLE BLADE TIPS

Send for Bulletin P-234

HETHERINGTON & BERNER, Inc.

INDIANAPOLIS, IND.

Builders Of Asphalt Paving Machinery For 30 Years

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

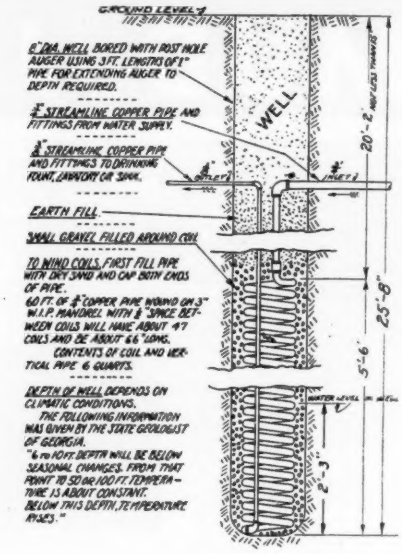
The Water Wheel

METERING services in Tucson, Ariz., is the sole cause of elimination of wastage and decrease of 50% in consumption—from 1060 gal. per tap in 1922 to 512 this year. Each meter reduced power costs by an amount almost equal to its purchase price during every year of service. However, meters have been of no value in reducing peak loads; in fact, while the average daily pumpage has been lowered the maximum hourly rate has increased. This is probably because a metered consumer is more particular to derive the maximum benefit from all water used, and irrigates at the most favorable hour of the day, which, in summer, is about 7 p. m., which corresponds exactly with the time of peak load. Over half the total supply is used for irrigating lawns and trees. The maximum rate of pumpage is more than 4 times the average and 14 times the minimum rate. One rainy day decreases the revenue $100, as does a 2° drop in the average temperature for a month.[G8-1]

Pumps for water works have reached a point in development where reciprocating steam pumps are no longer being installed, being replaced with centrifugals, driven by electric motor, diesel engine or steam turbine. Efficiencies of about 90% are now obtainable in the larger centrifugals and probably will not be increased materially. The most commonly employed driving element is the electric motor—generally synchronous motors in sizes over 100 hp. The steam turbine is commonly used where steam boilers have already been installed, the steam economy of the modern steam turbine driven pump being high. The diesel engine is being used increasingly in sizes under 400 hp. in situations where it can compete with other prime movers; it is still in the development stage, rapid strides being made in reducing the weight and consequently first cost per horsepower.[B8-1]

Low water in the suction well at Quincy, Ill., caused by low water in the river, caused the pumps to suck air. The intake pipe at the well was then half out of water. The suction well (which was in rock) was lowered and the pump suction lengthened. The intake pipe was then made into a siphon by bolting onto the 36″ flanged gate valve attached to its end a 36″ 90° ell with the vertical end long enough to reach about 5 ft. below low-water mark. A 1″ connection was made between the top of this ell and the pump suction, so that the vacuum pump primed siphon and pump at the same time. This manner of using a siphon was believed by the author to be unusual if not unique.[A7-10]

Cooling water for drinking fountains in public parks, golf links, etc., is effected at little expense by the Atlanta, Ga., water department. A coil of ¾ inch copper pipe wound on a 3 inch mandrel, with a length of 5.5 ft. was placed in the bottom of an 8 inch well about 25 feet deep and connected to a ¾ inch service pipe, and the well was then filled with small gravel. Water passed through the coil was reduced from the tap water temperature of 87° F. to 66°—the same temperature as water from wells in the vicinity.[G7-2]



Underground water cooling scheme at Atlanta

Zero softened water causes corrosion, presumably because it is a good electrolyte (zeolite softening increases rather than removes mineral content of hard water), and electrolytic action takes place between iron and other metals—zinc, copper or brass. Dissolved gases may play a considerable part. The preventive is to use only one kind of metal for pipe and fittings—all black iron or all copper; or else to mix with it enough unsoftened water to give a calcium carborate content of 20 to 35 ppm.[A6-23]

Slow sand filters were designed and constructed in 1933 for Newburyport, Mass., instead of the more customary rapid sand, because: The supply was a mixture of ground and surface waters of varying proportions, each requiring filtration, and it was felt that it would require an experienced chemist to secure proper coagulation of this mixture. Studies showed that sufficient color and iron removal could be obtained without the aid of chemicals. The consumers strongly desired to avoid chlorination, which would more probably be necessary with a rapid than with a slow sand filter. A substantial part of the cost of a slow sand filter could be saved by using the walls and bottom of an existing one, and construction of it would give more employment to local labor.[B8-9]

Taste and odor prevention suggestions: For algae-growing reservoirs—let no water go over the spillway, if possible; draw off from the bottom all that can be spared. For "metallic" tastes, flush the mains. For phenol tastes—discharge of phenol wastes into city sewers and mixing with sewage seems to destroy the phenols. Permanganate of potassium is successful with some waters. For tastes due to sulphite wastes—superchlorination followed by dechlorination; or chlorine and ammonia. A slow sand filter is a little more efficient than a rapid sand in removing odors and tastes. In using aeration, the spray should be broken finer than some aerators do. Lime is effective for some flavors; absorbent clay with some. Sodium hyposulphite and sulphur dioxide have been used for removing an excess of chlorine.[B8-2]

Swamp and sulphite wastes pollute water supply of Waterford, N. Y., giving persistent woody tastes. Pre-

chlorination, with and without ammonia; permanganate of potash; sodium aluminate before and after alum application; activated carbon; sulphuric acid for pH correction; all have been tried. Almost perfect water was obtained by baffles to eliminate short circuiting in basin; air jets to condition floc; pH control; and spray-nozzle type aerator to handle filter effluents. Activated carbon cut filter runs 50% and played hob with chemical costs. Carbon is used as an emergency standby for extreme conditions; 2 lbs. in 10 minutes to the basin effluent (flowing 50,000 gph), applied every 2 or 3 hrs., cleans up objectionable conditions in fair shape without markedly decreasing filter runs.[B8-3]

Copper sulphate continuously used appears to have "developed a strain of microorganisms which are resistant to the action of copper sulphate" in Cape Pond, at Rockport, Mass. Since 1922 this pond was treated with copper sulphate at least once a year—three or four times since 1929, each application being from 0.5 to 0.7 ppm. Generally there is a reduction of 10% to 96% in number of organisms; but four times during the past 3½ years there has been an actual increase, although on one of them the predominating *Tabellaria* was practically eliminated but was replaced with *Chlomydomonas*. Ten to 18 days generally elapse after treatment before the full effect upon the microscopic organisms is observed.[B8-4]

Lake Michigan pollution is worst between Indiana Harbor and the Calumet river—the most polluted area along the entire Great Lakes. To solve the problem presented requires intelligent cooperation among the cities from Gary to Hammond and between these and the Chicago Sanitary District. It is not necessary that the sewage disposal of all these cities be handled by one authority (although this would have its advantages) but there should be such cooperation that the efforts of one community may not be nullified in part or in whole by other communities. Improved sewage disposal for these cities is vital for the continued use of Lake Michigan as a source of water supply.[A7-2]

Ferric chloride storage tanks are preferably made of rubber-lined steel or of dense concrete protected by latex, or asphaltum and felt linings. "A good type of asphaltic lining for concrete tanks may be produced as follows: 1—Dry the tank thoroughly after the concrete has been well cured. 2—Wash the interior and top surfaces with a solution of hydrochloric acid, and rinse with water. 3—Allow to dry *thoroughly*. 4—Apply to interior and top surfaces a hot coat of asphaltic mixture made up of equal portions of Texas and Trinidad asphalts. 5—Apply a triple layer of Johns-Manville, or equal, asbestos roofing felt 32 inches wide and mop each layer on thoroughly with the hot asphaltic above described (4). 6—Apply a second hot coat of asphaltic mixture, over the felt, as in (4)."

For dissolving solid ferric chloride in the tank, the simplest plan is to puncture the drum with a pick and set it in the tank on blocks to raise it slightly above the bottom, and add water to completely submerge the drum. A 100 lb. drum in 70 gal. of water has been so dissolved in 30 min. Ferric chloride is irritating to the skin and particularly so to the eyes; in case of splashing on them, apply bicarbonate of soda, followed by zinc peroxide ointment to the skin, and a 2% solution of the former for the eyes.[A7-10]

Bibliography of Recent Water Works Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *t*, technical article.

A *Journal, American Water Works Association*

8 *July*

1. The Chicago Stock Yards Fire, May 19, 1934. By L. D. Gayton, pp. 803-811.
2. *t*. An Analytical Method of Determination of Leakage in Wood Stave Pipe. By A. A. Surin, pp. 812-821.
3. New Filtration Plant at Albany, N. Y. By E. B. Whitman, pp. 822-840.
4. Shortage of Public Water Supplies in the United States During 1934. By G. F. White, pp. 841-854.
5. New Water Softening Plant and Cleaning Existing Water Mains at Woodstock, Ill. By J. A. Fulkman, pp. 855-865.
6. The Art of Planning as Related to Watershed Control. By M. W. Cowles, pp. 866-875.
7. *t*. Sterilizing Velocities of Chlorine and Chloramine under Varying Conditions of Organic Load and pH. By P. J. Beard and N. J. Kendall, pp. 876-887.
8. *t*. Evaluation of Residual Chlorine. By A. E. Griffin, pp. 888-896.
9. Aeration of Water by Air Diffusion. By F. C. Roe, pp. 897-904.
10. A Planned Future for the Distribution System. By C. B. Bird, pp. 905-911.
11. The State's Interest in Our Water Resources. By W. H. Frazier, pp. 912-917.

B *Journal, New England Water Works Association*

8 *June*

1. Pumping Water—An Historical Review. By W. H. Sears, pp. 119-148.
2. Taste and Odor Control in Public Water Supplies. By J. M. Caird, pp. 149-151.
3. Taste and Odor Control in the Small Plant. By R. G. Yaxley, pp. 152-155.
4. Control of Tastes and Odors in the Water Supply of Rockport, Mass. By G. C. Houser, pp. 156-161.
5. Betterment Assessment Method for Financing Water Main Extensions. By S. R. Wrightington, pp. 162-169.
6. The Action of Water on Materials for Service Pipes. By F. W. Gilcreas, pp. 170-175.
7. Freezing and Thawing of Water Mains and Services, By A. A. Ross, pp. 176-181.
8. Roadside Water Supplies. By E. W. Campbell, pp. 182-186.
9. Slow Sand Filtration Plant, Newburyport, Mass. By P. F. Howard, pp. 187-199.
10. Responsibility of Water Utilities for Collapse of Hot Water Boilers Resulting from Pressure Drop in Main. By W. P. Sullivan, pp. 200-205.
11. Completing Second 48-inch Force Main, New Bedford, Mass. By S. H. Taylor, pp. 206-211.
12. *c*. Manufacture and Construction of 48-inch Lock Joint Pipe Line, New Bedford, Mass. By F. F. Longley, pp. 212-220.
13. Chlorination of 48-inch Pipe Line, New Bedford. By E. J. Sullivan, pp. 221-224.

D *The Surveyor*

8 *June 21*

1. Steam Turbine Borehole Pumping Figures. By J. F. Haseldine, p. 763.
2. *c*. Construction of Burnhope Reservoir, Durham. By S. S. Alderidge, pp. 765-766.
3. Bulawayo Municipal Waterworks. By F. C. Whitmore, pp. 767-768.
4. The Allnaheglish Dam, Londonderry Waterworks. By W. Criswell and W. & T. R. Osmann, pp. 771-772.

June 28

5. *c*. Construction of Burnhope Reservoir. Discussion, pp. 821-824.

July 12

6. Water Purification Practice in Cape Town, pp. 33.

E *Engineering News-Record*

8 *June 27*

1. Principles of Siphon Design for Colorado River Aqueduct. By D. B. Gremensky, pp. 899-903.
2. *c*. Concrete-Placing Methods on Chicago Sewer Tunnels, pp. 911-914.

F *Water Works Engineering*

8 *June 12*

1. Waukesha Improves Its Plant. By A. P. Kuranz, pp. 674-677.
2. Interference of Algae with Tests for Residual Chlorine. By E. W. Johnston and W. H. Edmonds, pp. 688-689.

G *Water Works and Sewerage*

8 *July*

1. A 13-year Record of the Operation of a Municipal Water Department. By L. R. Burch, pp. 233-236.

J *American City*

8 *July*

1. Underground Dam Impounds Water for Harrisonburg, Va. By Allen B. McDaniel, pp. 61-62.
2. Water Rates and Service Charges (in 12 cities) pp. 81, 83, 85.

M *Canadian Engineer*

8 *June 25*

1. Causes and Control of Tastes and Odors in Public Water Supplies. By N. J. Howard, pp. 14-18.

P *Public Works*

8 *July*

1. Developing a Water Supply for the Tygart Valley Homesteads. By E. T. Roetman, pp 13-14, 16
2. Zeolite Water Softening Plant Built with FERA Funds. By C. P. Hoover, pp. 23-24.
3. Metering and Water Consumption, pp. 26, 30.

T *Technique Sanitaire et Municipale*

8 *June*

1. Le Procede de Regeneration des Eaux de Piscine en Circuit Ferme, pp. 138-141.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

The Digestion Tank

DIGESTION gas at Eastleigh, England, is used to generate electricity to operate pumps for lifting sewage—the only plant in England where this is done. With a daily sewage flow averaging 871,097 gal. (British) in July, from 23,000 population, 81% of the power required was obtained from this gas, the other 19% with oil fuel used in the same 75 hp. engine. The total gas consumption in 1934 was equivalent to 0.61 cu. ft. per capita. The saving by using gas was estimated at $1,250 for the year. When running on full load, the engine used about 28 cu. ft. of gas per kwh generated; the average for day and night consumption was 35 cu. ft. The exhaust gases from the engine are used to heat the sludge; on very cold days some additional heat is obtained by means of a coke boiler. The sludge in the tanks is kept at a constant temperature of 78° to 80° F.

The plant is quite complete, including Dorr screens, aerated oil interceptor, two-story sedimentation tanks, primary and secondary digestion tanks, percolating filters and humus tanks, and open sludge drying beds; with special tanks for storm water overflow. Considerable trouble was experienced with scum forming in the primary digestion tanks, to which sludge from the sedimentation tanks was discharged by hydrostatic pressure twice a week; also grease and floating matters from the sedimentation tanks was run into the primary tanks. In an effort to overcome this trouble, two-stage digestion was discarded and all tanks used as single-treatment tanks. The supernatant water is found in a band located about two-thirds the depth from the bottom. The sludge is held in the tanks for about 19 weeks. The total solids of the sludge in the sedimentation tanks averages 85.4 ppm and in the digested sludge 126 ppm.

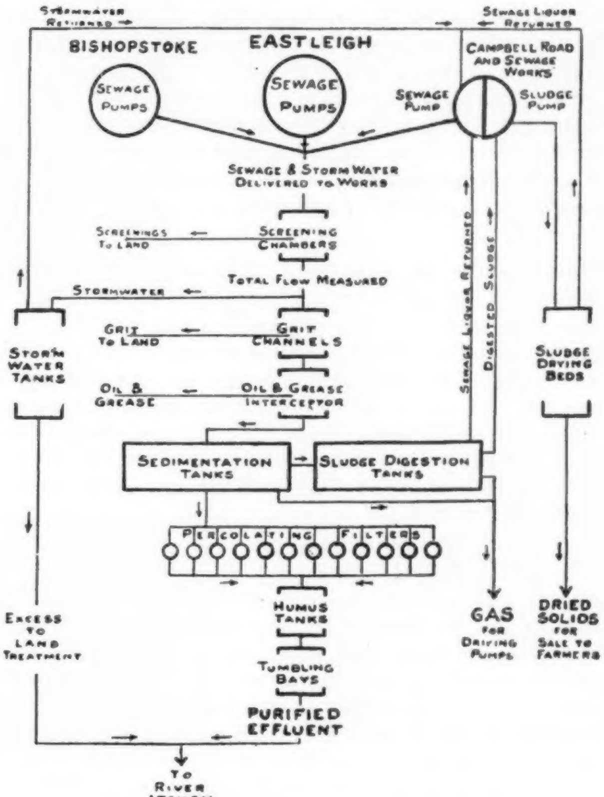


Diagram of Eastleigh Sewage Disposal Works

Brush aeration has been tested by the New Jersey Agricultural Experiment Station at the Marlboro State Hospital, begining in 1931. In 1933 duplicate brush and porous tube tanks were installed and operated simultaneously or independently, at will. The sewage aerated was first settled in a primary tank. The amount averaged about 400,000 gpd. with a maximum rate reaching 1 mgd. The brush aerators from July 1933 to February 1934 averaged removal of B.O.D. of 99%; suspended solids 92.8%; when the brushes revolved at a speed of 80 rpm., and when the speed was 44 rpm., from February to July 1934, the removal averaged 96.6% B.O.D., 95.4% suspended solids.

From the operation of this plant it was concluded that the brush type of aeration was very satisfactory, providing an economical supply of oxygen to the aerators, adequate circulation velocities in the aerators to prevent deposition of solids at minimum oxygen supply requirements, excellent purification of the sewage liquids, low maintenance cost, and easy accessibility to all parts of the aerating mechanism. The chief disadvantage appears to lie in the tendency of the process to form a sludge which is voluminous in character and which concentrates to a comparatively low solids content, requiring greater settling capacity in the final settling tank, greater sludge digestion capacity and increased drying facilities than ordinarily reported at other plants.[H6-1]

Determining dissolved oxygen by a new colorimetric method was described by Moses L. Isaacs. It uses amidol and potassium citrate. The action is carried out in test tubes and comparison is made with permanent standards made of solutions of cobalt chloride and potassium dichromate. The colorimetric determination may be made with a Dubosque Colorimeter or with a comparator block, using tubes of permanent standards, or by diluting a given quantity of the permanent standard. While the method has a number of limitations, it is proposed for field studies and small laboratories because of the simplicity of the procedure and the portability of the apparatus; also for determinations of biological oxygen demand and comparative studies of oxygen content in a given water supply. It was tried out by F. W. Gilcreas, who made comparative determinations with the Winkler method on various types of water and found "excellent agreement"; while comparison with the standard procedure for B.O.D. determination showed less than 10% variation.[C7-6]

Filtering sewage was studied at the Coney Island plant, using two sedimentation tanks, one equipped with a Laughlin magnetite filter, the other plain, by Rudofs, Brendlen and Carpenter. These showed that doubling the settling period increased the removal of suspended solids 65% and of B.O.D. 100%. But one hour of settling followed by filtering produced greater reduction than two hours of plain settling. With stronger sewage the detention period became more important. Increasing the filter rate two or three fold did not affect the removal of solids. Better results were obtained with high filter rates and short settling periods than were possible by settling alone. It was apparent that the addition of a filter at plants where sedimentation alone is insufficient might carry a plant over seasonal deficiencies. Also, that a saving in cost of settling tank capacity in original plans might be made. Combining use of chemicals to improve settling and filter to finish off the effluent would apparently more than double the clarifying capacity of a plant.[H7-2]

Clarification of sewage is explained by theories "generally founded on more or less pertinent analogies with more amenable systems rather than on the direct examination of sewage colloids or bio-colloids." "No single theory has been proposed that will account satisfactorily for all of the diverse phenomena of sewage clarifiction and stabilization." Physical or colloidal theories explain purification by either coagulation of colloids or absorption by sludge, frequently overlooking subsequent biological oxidation; while biological theories ignore the preliminary process of clarification.

Colloidal theories disregard the large amounts of sewage solids which are not colloidal, and "can not account for the removal of the considerable proportion of the nitrogenous and other oxygen-consuming impurities which are present in true solution. Bacteria in sludge may not have been transferred from the sewage, but may be due to local growth in a favorable medium, while the removal of bacteria from the sewage liquor may be due largely to bacteria-eating plankton rather than to precipitation. It is certain that coarser particles of raw sewage (those barely visible to the unaided eye) are attacked and distinegrated by various species of plankton.

In studying these theories, time is an all-important element. Some of the suggested processes approach completion in minutes, others in days, others in weeks. This rules out biological action as a major factor in primary clarification. "From various angles attention should be focussed on the floc itself as the primary absorbent, apart from embedded bacteria, secreted enzymes or attending protozoa." [C7-1]

Aeration of sewage, without use of activated sludge, prior to settling effects a 50% to 65% greater percentage of removal of suspended solids and B.O.D. than plain sedimentation. This is not due to oxidation, since the reduction of suspended solids and B.O.D. in 6 hrs. of aeration without sedimentation was negligible, but is due to the flocculating effect of air. It has been shown that the use of nitrogen or hydrogen for bubbling through sewage for six hours produced as good flocculation and coagulation as when air was used similarly. The stronger the sewage, the greater the percentage removal by aeration, and sedimentation; but return of settled (not activated) solids to artificially increase the solids concentration of the sewage results in an effluent with higher solids content.[C7-2]

Flushing sewers, according to English studies, is desirable when the grade is less than 1:200 for a 12" pipe, 1:300 for a 15" pipe . . . 1:750 for a 27" pipe. In removing gravel, stones, etc., depth of flow is more important than velocity, for in a deep stream the particles are thrown to a greater height than in a shallow one, and are carried further by the stream before settling to the bottom again because they have further to fall. Provided the sewer grade is reasonably good, a good flush rapidly discharged will keep it clean for at least half a mile even though its capacity is considerably in excess of normal flow requirements.[H6-3]
(Presumably the above refers to combined sewers, which are in more general use in England than the United States, and have a capacity much more greatly in excess of the dry-weather flow than separate sewers have.)

Subzero weather concrete construction was successful in building the St. Pierre sewer in Montreal, Canada, which is approximately 15 ft. square. Haste was compulsory, and work was prosecuted 24 hours a day, regardless of weather and temperature. Concrete was mixed in a central mix plant about a mile from the job. Concrete was poured when the thermometer was 20° below zero, and in sleet when steam jets had to be used to thaw ice off the steel and forms just ahead of the pour. In spite of these conditions, no leaks developed in the structure, even where it crossed under the Lachine Canal. The completed pours were heated by means of salamanders inside the forms and steam jets under tarpaulins on the outside.[M8-1]

Bibliography of Recent Sewerage Literature

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c, Indicates construction article; *n*, note or short article; *t*, technical article.

D *The Surveyor*
8 *July 5*
1. Sewage Pumped Under Its Own Power. pp. 5-6.
2. Eastleigh Sewage Disposal. pp. 9-10.

July 12
3. Sludge Digestion at West Kent. pp. 35-36.
4. Activated Sludge Treatment at Manchester. By E. Ardern and C. Jepson, pp. 43-45.

E *Engineering News-Record*
8 *July 18*
1. Sewer Lining Resists Gas Attack. By A. M. Rawn, p. 95.

G *Water Works and Sewerage*
8 *July*
1. Effect of Chlorine on Activated Sludge. By Willem Rudolfs and I. O. Lacy, pp. 237-241.
2. Mechanical Filtration of Sewage. By P. B. Streander, pp. 252-257.

H *Municipal Sanitation*
8 *July*
1. Reducing the Cost of Sewage Treatment. By W. B. Walraven, pp. 208-210, 219.
2. Municipal Refuse as Fuel. By H. W. Taylor, pp. 211-212, 221.
3. Trend in Sewage Plants, pp. 213-214.

J *American City*
8 *July*
1. Underground Sewage Pumping Plant at San Pedro, Calif. pp. 53-54.
2. Novel Heat Exchange for the Burlington Sewage Plant. By Robert Cramer, pp. 59-60.

M *Canadian Engineer*
8 *June 25*
1. *c*. Construction of St. Pierre Collector Sewer, Montreal. By B. Snow, pp. 7-11.

July 9
2 Mechanical-Chemical Methods of Sewage Treatment. By H. C. H. Shenton, pp. 9-12.
3. Odors and Their Travel Habits. By J. Van Benschoten, pp. 13-15.

P *Public Works*
8 *July*
1. Using Powdered Activated Carbon in Sewage Treatment. p. 12.
2. Chemical-Mechanical Treatment of Sewage. By P. B. Streander and M. J. Blew, pp. 17-18, 22
3. Performance of Geneva's Sewage Treatment Plant. By E. Roy Wells, pp. 20-22.

What's New?

A Modern Material Handling Cart:

The Ayrgo (pronounced air-go) material handling cart is an example of modern design which ought to produce economy on any job. It will handle wet concrete, having sufficient capacity to take the full discharge of a 10S mixer, dry batches, bulk cement, or any other material that needs handling. The actual volume capacity is 11 cubic feet; it is designed to handle 1900 pounds load; it weighs 260 pounds.

The handles, which are shown in the illustration, permit full control of the load, no matter what the angle of the cart—as for instance when loading with bulk cement, when the scooping lip is run into the material and the body then brought to an upright position. The whole unit is easy to handle.

The body is steel, with electrically welded joints. The tires are pneumatic, 5 x 15, which won't fit any automobile, and thus discourages theft. The wheels have roller bearings. All in all, this is a fine unit that ought to cut costs quite materially on any construction or repair job. It will be handled through equipment dealers and jobbers, but write Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh, Pa., for detailed description.

Ayrgo Material Handling Cart

"Wrigraph" for Better Drafting

Combining a drawing board and a drafting machine, this instrument announced by L. G. Wright, Inc., 5713-17 Euclid Avenue, Cleveland, Ohio, is made in three sizes. The illustration shows the Model A size, 18" x 24" board and protractor triangle. The Model B has a 12" x 18" board; the Junior is a complete unit with board size 10" x 12". The board is made of ¼" black prest-

Wrigraph Complete Unit

wood and is equipped with clips which hold either a single sheet or a pad of paper. No thumb tacks are required. The triangle attachment gives angles of 15, 30, 45, 60 and 90 degrees without reference to the protractor. The right-angle sides are graduated to ⅛ or 1/10". Interchangeable attachments on the parallel device make it possible for the technical man to purchase only that part of the equipment he requires.

Multi-Stage Turbo Blowers:

The method of operation and the characteristics of a turbo-blower are substantially the same as those of a centrifugal pump. Drive may be by steam

Allis-Chalmers Turbo Blowers

turbines or electric motors, with speed increasing gears sometimes needed—more especially in the smaller installations which operate at high speeds. This equipment is suited to many industrial installations, and also to sewage plant operation. Allis-Chalmers turbo-blowers are fully described in Bulletin 1909, which gives a great deal of technical data on their use and characteristics. Sent on request to Allis-Chalmers Mfg. Co., Milwaukee, Wisc.

Other new equipment is shown on page 46

Dresser Couplings for Water Lines.—A new booklet on pipe joints intended to assist those having to do with construction, operation or maintenance of pipe lines. Includes a number of installation pictures and detailed information on building pipe lines. Write Dresser Mfg. Co., Bradford, Pa., asking for Form 355.

Road Construction Data. — The Heltzel Leveler Grader is described in Bulletin Q-7, just issued; the rapid dowel and expansion joint spotter, another money saver for the road builder, is described in Bulletin Q-6. Heltzel Road Form Bulletin 101 covers all that the title implies. Sent on request to Heltzel Steel Form & Iron Co., Warren, Ohio.

Breaker and Sheeting Driver.—This is an air-operated breaker designed for heavy demolition, but also convertible into a sheeting driver. Blows are hard, slow and effective. Ask for Bulletin W-1200-B12, Worthington Pump and Machinery Corp., Harrison, N. J.

Lubrication Equipment. — Alemite Corp., Chicago, Ill., is issuing its 25-page Alemite Powergun catalog, describing all equipment and accessories necessary for complete lubrication. Prices, details and specifications. Sent on request.

Diesel Engines.—Single and twin-cylinder horizontal diesel engines are fully described in a 12-page bulletin issued by Cooper-Bessemer Corp., Mt. Vernon, Ohio. 25 to 110 horsepower. Sent on request.

American Water Works Association:

The 1936 annual convention of this association will be held at Los Angeles, Calif., June 29 to July 3, 1936. The headquarters will be at the Hotel Biltmore.

New England Water Works Association:

Nominees for the coming year have been made as follows: For president, Roger W. Esty, superintendent of waterworks, Danvers, Mass. For vice-president, Warren J. Scott, director of Sanitary Engineering, Connecticut State Department of Health. For director, Harold K. Barrows, professor of hydraulic engineering, M. I. T. For treasurer, Leland G. Carlton, water registrar, Springfield, Mass.

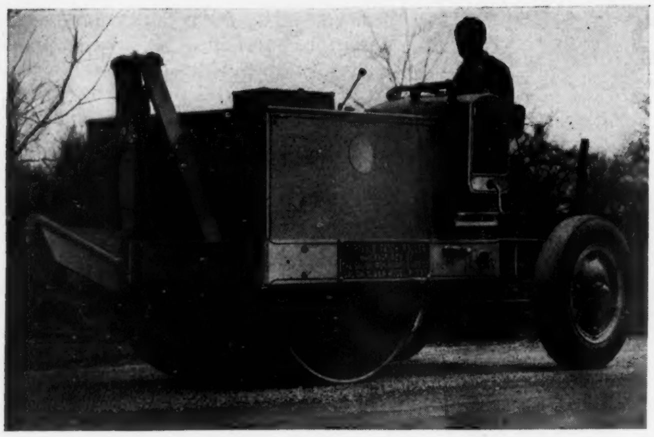
L. F. Livingston, manager of the Agricultural Extension Section, Explosives Department of the duPont Co., has been elected president of the American Society of Agricultural Engineers.

John Van Nostrand Dorr, president of the Dorr Co., has returned from a trip to the Pacific coast, in the course of which he revisited the Black Hill section of So. Dakota where, 30 years ago, he invented the classifier, thickener and agitator which bears his name. He was accompanied by his daughter, Mrs. Knox Harden of New York, who was born in the Black Hills.

Professor S. S. Steinberg, head of the Department of Civil Engineering, University of Maryland, has been selected as the first head of the newly organized Education Division of the American Road Builders' Association.

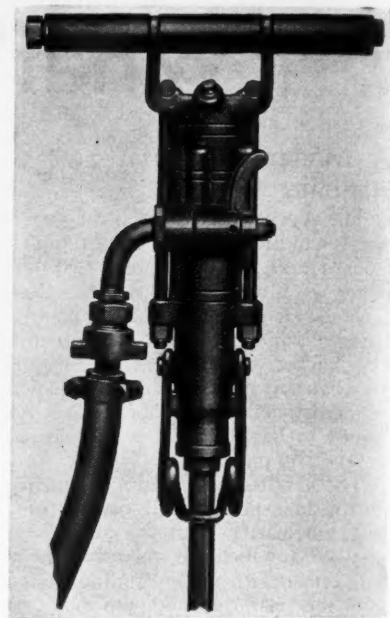
Major Walter R. Macatee will be in charge of the new Cincinnati office of the Asphalt Institute, with quarters in the Enquirer Building.

O. Q. Hinds has joined the Caterpillar Tractor Co. as special road machinery representative.

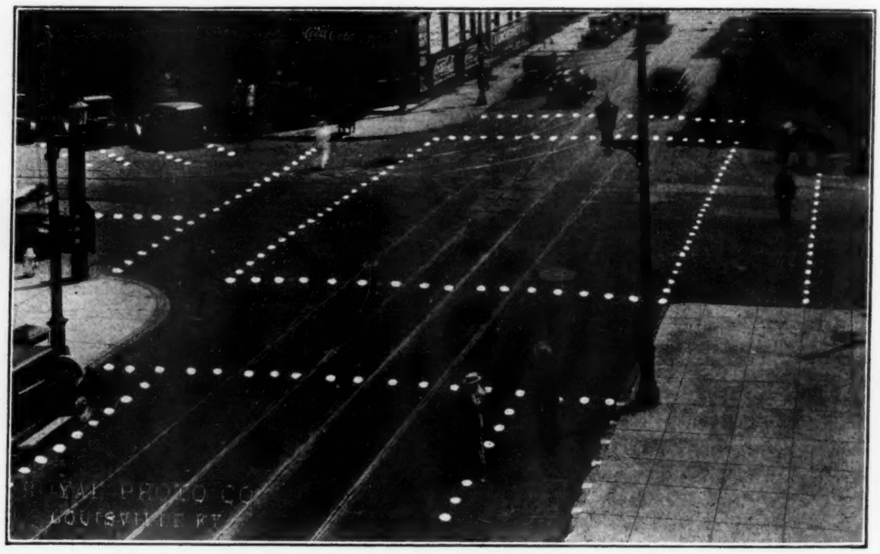


The new Galion roller is a money saver

At the right: the CP-22 dry light Sinker put out by the Chicago Pneumatic Tool Co., New York City, N. Y. Weighs 28 pounds; economical drilling depth 6 to 8 feet



Below: Littleford Traf-O-Dots mark off crosswalks and other areas clearly and economically



A Portable Patch Roller:

This is something decidedly new in the line of rollers, and we would say that it fulfills the manufacturer's claims that it is a low-cost machine of great versatility. Recommended for rolling all kinds of patch material, for compacting loose material, it is a most handy piece of equipment for villages, towns, cities, etc. Weighs up to 8600 pounds; and it is claimed that it will give the same service as any conventional 5 to 7-ton roller.

Highly portable; attach it to a truck, with the roll off the ground and go places fast. The roll will take up to 2300 pounds of water, when it is desired to increase the weight. The illustration shows the general appearance of this new unit. Write Galion Iron Works & Mfg. Co., Galion, O., for further information.

New Austin-Western Hydraulic Scraper

This large capacity, 12-yd. scraper digs, loads, hauls and dumps more, at a faster rate, according to the Austin-Western Road Machinery Co., of Aurora, Ill.

Constructed throughout of special alloy steel, to make it lighter in weight but stronger, and welded, this self-contained scraper carries its own motor, hydraulic pump and primary control apparatus. The only connections between tractor and scraper are the drawbar pin and a small electrical cable (with quick release attachment plug). With this construction and arrangement, the entire output of tractor power is devoted to pulling the scraper; the tractor can be disconnected for other work in less than two minutes time.

The "remote" control, consists of electrical push-down switches, positioned at operator's elbow, which actuate hydraulic valves, located on the scraper, to control all digging, carrying and unloading. Scraper has open top for loading with shovel or elevating grader if desired.

The load is forced out; not dumped. Wheels are equipped with Timken bearings and 13.5 x 20 in. pneumatic tires.

Austin-Western Hydraulic Scraper